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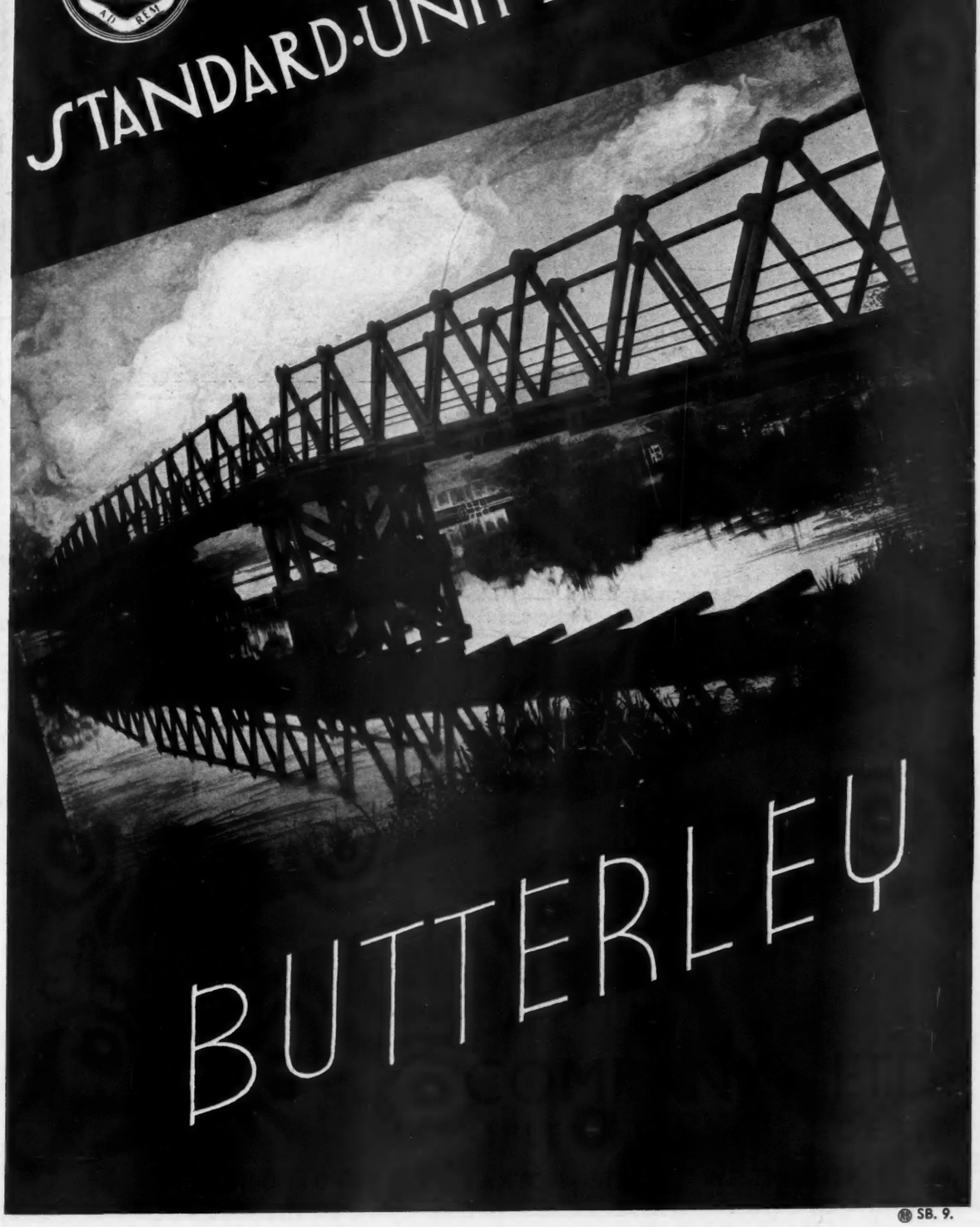

BUTTERLEY

SB. 9.

Famous Roads — No. 2, Great North Road

This ancient highway—London to York and on to Edinburgh—noted in the Turnpike Act of 1663, has played a leading part in the development of this country.

Partly following the course of the Roman Ermine Way from London to Lincoln, it breaks away at Alconbury and runs for 325 miles to Edinburgh. In early times it was studded with post houses and inns, and to-day there still remain many fine examples, including the famous "Angel & Royal" at Grantham.

Originally a Wayside House of the Knight Templars, it was here in 1213 that King John held court, and, in 1483, King Richard III (Crookback) signed Buckingham's death warrant. Grantham—astride the Great North Road—already historically famous, is probably better known for its association with road building all over the world; it is the home of Aveling-Barford Ltd., originators and World's largest makers of Road Rollers.

Leaders in the field of road construction and building equipment since 1867, Aveling-Barford present-day designs, created to meet the demands of war-time road and aerodrome construction, are destined to play a major part in the rebuilding of Britain's highways.

AVELING BARFORD LTD.

GRANTHAM INVICTA ENGLAND

LEADERS IN ROAD CONSTRUCTION AND BUILDING PLANT

The Engineer

LONDON, FRIDAY, OCTOBER 15, 1943.

PUBLIC NOTICES

OROUGH OF CHRISTCHURCH

AIR-COMPRESSING MACHINERY

nders are Invited for the

SUPPLY of an OIL ENGINE and AIR PRESSOR for Sewage Disposal Purposes. achinery is to be capable of raising 600 feet of free air per minute to a pressure lb. per square inch.

ders must include for Cold Starting, a ne Silencer and all Accessories, and the of delivery must be stated.

withstanding the specification of an Oil e, manufacturers may, if they wish, submit als for the employment of any kind of , provided the scheme is adapted to the ne named and will give the required rmance.

led and endorsed Tenders to be received by undersigned not later than Monday, mber 15th.

E. B. WISE,
Borough Engineer and Surveyor.

wn Hall,
Christchurch,
1st October, 1943. 8393

E MINISTRY OF LABOUR AND NATIONAL SERVICE

e Ministry of Labour and

NATIONAL SERVICE, CENTRAL HNICAL and SCIENTIFIC) REGISTER, es APPLICATION for APPOINTMENT to rnment POSTS in India.

pointments will be for the duration of the with a minimum period of one year, subject ree months' notice on either side.

ll passage both ways is provided. Bonus rmination of service.

the recommendation of the Interviewing d, a candidate may be granted an initial y above the minima in the scales admissible pect of the two posts reference C.1911A and A below.

e vacancies with the qualifications required e posts are detailed as follows :—

USTRIAL PLANNING OFFICER (General), Reference No. C.1911A.

od general education, sound mechanical ing, and at least five years' subsequent rvisory experience in recognised mechanical hop. Experience in Mass Production tial, preferably some knowledge of Scientific rument Production.

lary £840 per annum, rising by £45 per m to £1020 per annum.

ESIGN OFFICER, Reference No. C.1912A.

e not over 45. First-class Mechanical Engi- with up-to-date experience in Design of t Mechanical Engineering Work. Must have at least three years' first-hand experience in rn Production Methods, also at least two s in Drawing-office, of which one year should been on Development of New Designs. ld preferably be familiar with one or more llowing classes of Engineering Products :— Small Pumps and Fittings, all types. Handling Equipment : Small Cranes, strial Trucks, &c. Should have adaptability, ative, and ability to work in unfamiliar con- ns with limited production facilities and rials.

lary £840 per annum, rising by £45 per m to £1020 per annum.

ASSISTANT INDUSTRIAL PLANNING FICER (Ammunition), Reference No. C.1913A.

e limit 45. Should have had first-class anical training and knowledge of Modern ods of Production and specialised experience ight Press Tool Work and Machinery Com- nts for Air Bomb.

st be capable of dealing with contracting , both by personal visits and by corre- dence.

lary £630 per annum to £720 per annum -incremental). Pay to be fixed in light of lifications and experience.

ASSISTANT INDUSTRIAL PLANNING FICER (Non-Ferrous), Reference No. C.1914A.

st have had at least five years' experience in uction of Non-Ferrous Metals and Alloys, ld be familiar with Wire Drawing, Sheet Strip Rolling, and Sand Casting and trodepositing. Office experience necessary ; rience of Analytical Work advantageous.

lary £630 per annum to £720 per annum -incremental). Pay to be fixed in light of lifications and experience.

ASSISTANT INDUSTRIAL PLANNING FICER (Tools), Reference No. C.1915A.

e about 35. Good experience in Machine Process Planning with Jig Design experi- also. Must have held post in Production neer's Office in large works.

lary £630 per annum to £720 per annum -incremental). Pay to be fixed in light of lifications and experience.

pplicants should write to the MINISTRY of OUR and NATIONAL SERVICE, CENTRAL HNICAL and SCIENTIFIC) REGISTER, EXANDRA HOUSE, KINGSWAY, LONDON, , for the necessary application forms and quote the reference number of the post for they wish to apply. 8433

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE
ARRANGED FOR CARD INDEXING
(TABLE OF CONTENTS, PAGE 306)

Engineers and the British Empire No. XV (P. 299)
(C. A. M. SMITH) THE ENGINEER, 15 - 10 - 43

John Henry Hamilton and the Positive Scavenging Engine—No. II (P. 301)
(A. K. BRUCE) THE ENGINEER, 15 - 10 - 43

Telecommunication (P. 310)
(SIR A. S. ANGWIN) THE ENGINEER, 15 - 10 - 43

Threshold of a New Era in Transport (P. 305)
(SIR W. V. WOOD) THE ENGINEER, 15 - 10 - 43

The Engineer, the Architect and the Surveyor (P. 303)
(H. J. MANZONI) THE ENGINEER. 15 - 10 - 43

Battleships of the Future (P. 306)
THE ENGINEER, 15 - 10 - 43

Hush-Hush (P. 307)
THE ENGINEER, 15 - 10 - 43

HYDROJET ASH & DUST SLUICING
BABCOCK & WILCOX LTD.

INDEX TO ADVERTISEMENTS, PAGE 51

THE FACT that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

PUBLIC NOTICES

Notice is Hereby Given that MESSIER AIRCRAFT EQUIPMENT, Limited (formerly known as Rubery Owen Messier, Limited), RUBEN HADEKEL, and ALFRED ARNOT SEEK LEAVE to AMEND the SPECIFICATION of the Application for Letters Patent No. 552,712, entitled "Improvements in or relating to Hydraulic Remote Control Apparatus."

Particulars of the proposed Amendment were set forth in the Official Journal (Patents) No. 2849, dated September 1st, 1943.

Any person may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the PATENT OFFICE, 25, SOUTHAMPTON BUILDINGS, LONDON, W.C.2, on or before the 1st October, 1943. 8420

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN SITUATIONS OPEN SECTION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge, and co-operation is asked for.

PUBLIC NOTICES

CITY OF LEICESTER EDUCATION COMMITTEE

THE GATEWAY SCHOOL
Headmaster : E. C. WHITE, B.Sc.

Wanted, a Master for Engineering, whose main work will be the Teaching of Engineering and the Organisation of Junior Technical Classes for Boys of 14 to 16 years of age. The work will be carried out in the College of Technology and Commerce, where the Technical Classes for Boys from the Gateway School are held. In addition, he may be required to undertake some teaching work with full-time or part-time Senior Students. Good industrial experience is required ; a degree or its equvalents will be an added qualification.

The Gateway School is a school working largely on the lines of the Technical High School envissaged in the Spens Report.

Salary will be according to the Burnham Scale with an additional payment of £25 per annum for the Post of Special Responsibility.

Application by letter, giving details of qualifications and experience, accompanied by copies of recent testimonials, should be addressed to the Headmaster as soon as possible.

H. S. MAGNAY,
Director of Education.

Education Department,
Newarke Street,
Leicester.
12th October, 1943. 8445

PUBLIC NOTICES

Overseas Employment.—The following skilled MEN are URGENTLY REQUIRED for the Tropics. Categories (A) to (E) and one of the M. and E. Chargehands will be required to work in an isolated desert station, where the climate is good, but water scarce. Men not prepared to accept such conditions should not apply. The salaries mentioned below cover all hours worked up to 51 per week. All periods of 3 hours or parts of 3 hours after 51 are subject to a bonus of 15s. Appointment is for 18 months. Leave with pay at rate of 1½ days for each month served. All posts carry kit allowance of £25, free quarters and camp kit.

(A) 3 ENGINE DRIVERS, to Operate and Carry Out Running Repairs of Diesel-electric Generating Plant up to 130-kW capacity. Salary, £375 single men, £500 married men.

(B) 2 SWITCHBOARD ATTENDANTS, to Operate Switchboards Controlling Alternators up to 130 kW, running either singly or in parallel. Maintenance and Adjustment of Electrical Plant, including Alternators, Exciters, Isenthal Automatic Voltage Regulators and General Powerhouse Auxiliaries. Salary, as for (A).

(C) 1 ENGINE DRIVER FITTER for Operation, Erection, Adjustment and Overhaul of Stationary Diesel Engines up to 200 H.P. and their Auxiliary Plant, including Air Blast Radiator Water Coolers, Oil Coolers, and Fuel Storage Installation. Salary, £400 single, £525 married.

(D) 2 FITTERS with Steam experience, for Operation and Maintenance of Water Distillation Plant, Overhaul and Repair of Diesel and Petrol Engines up to 50 H.P., General Bench Work and Pipe Fitting. Salary, as for (C).

(E) 2 ELECTRICIANS, for Installation and Maintenance of Internal Wiring Systems for Lighting, Fans, and Power ; Overhaul and Repair of A.C. Motors and Fans ; Maintenance of Overhead and Underground Distribution Systems up to 3300 volts. Salary, as for (C).

(F) 7 M. and E. CHARGE HANDS for Installation and Maintenance of Overhead and Underground Electrical Distribution Systems, including Transformer Sub-stations up to 3300 volts, also for Internal Wiring Installations for Lighting, Motors, and Fans ; Operation and Maintenance of Water Pumping and Purification Plants ; Supervision of Diesel-electric Generating Plant up to sets of 130-kW capacity ; knowledge of Refrigerator Maintenance an advantage. Salary, £425 single, £550 married.

(G) 1 M.T. FOREMAN, to Supervise Maintenance and Repair of Mechanical Excavating and Road Plant and Lorries. Salary, £450 single, £575 married.

(H) 5 M.T. FITTERS to work under (G). Salary, as for (C).

(I) 1 CABLE JOINTER for Jointing H.T. and L.T. Paper-insulated and Lead-covered Underground Cables. Salary, as for (C).

Written applications (no interviews), giving full details of age, apprenticeship or training, experience, name of present employers, and National and Armed Forces Registration Numbers, should be sent to the SECRETARY, OVERSEAS MAN POWER COMMITTEE (Ref. 390), MINISTRY OF LABOUR AND NATIONAL SERVICE, ALEXANDRA HOUSE, KINGSWAY, LONDON, W.C.2. 8419

PUBLIC NOTICES (continued) Page 2
SITUATIONS OPEN, Page 2
SITUATIONS WANTED, Page 2
AUCTIONEERS & VALUERS, Page 52
BUSINESSES and PREMISES For Sale, &c., Page 52
AGENCIES, Page 4
FOR SALE, Pages 4 and 52
EDUCATIONAL, Page 4
PATENTS, Page 2
MISCELLANEOUS, Page 4
MACHINERY, &c., WANTED, Page 2
SUB-CONTRACTING, Page 4

For Advertisement Rates see First Column Overleaf

CLASSIFIED ADVERTISEMENTS CLOSE FOR
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The Engineer

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ADVERTISEMENTS

The Charges for Classified Advertisements are 1/6 per line up to one inch—minimum charge, 6/-; those occupying one inch or more at the rate of 12/- per inch. Box numbers, 1/- extra, except in the case of advertisements under "Situations Wanted." Orders MUST be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Wednesday afternoon.

Letters relating to the Advertisement and the Publishing Departments of the Paper are to be addressed to the Publisher; all other letters are to be addressed to the Editor of THE ENGINEER.

Postal Address,
28, Essex Street, Strand, London, W.C.2.

Teleg. Address,
"Engineer Newspaper, Estrand, London."
Tel., Central 6565 (10 lines).

PUBLIC NOTICES

MINISTRY OF AIRCRAFT PRODUCTION

Applications are Invited for

TEMPORARY APPOINTMENTS in the following grades under the Ministry of Aircraft Production. Applications from men already employed in Government Departments will only be considered if they are forwarded through the Department concerned.

SCIENTIFIC OFFICERS.

Salary up to £675 inclusive of war bonus for males and £540 for females.

First or Second-Class Honours Degree in the relevant subject (see categories below) and not less than two years' research experience either at a University, Research Association, or in Industry. Exceptionally, research experience with less academic qualifications but with evidence of ability to direct juniors in specific research, will be considered.

TECHNICAL OFFICERS.

Salary up to £575 inclusive of war bonus for males, and £494 for females. In exceptional cases salaries above these figures would be considered.

A degree or its equivalent in the relevant subject (see categories below). Good practical experience is essential either in Experimental Work and/or Design and the ability to direct a small number of juniors. Some posts require administrative experience.

ASSISTANTS II.

Salary up to £450 (approx.) inclusive of war bonus and overtime for males, and £350 (approx.) for females.

Candidates subsequent to serving their time in the shops and drawing-office should have had experience in Research or Development in a relevant subject (see categories below), and have had theoretical training up to Higher National Certificate standard or its equivalent, as a minimum.

Candidates are required to have had experience in one or more of the following categories :—

(A) Stress Work in connection with Structures, preferably Aircraft.
(B) General Aerodynamic Work either model or full scale.
(C) Metallurgy candidates should specify their experience and state whether in ferrous or non-ferrous alloys.
(D) Small Electrical Equipment of types similar to those in use in Aircraft.
(E) Experimental Work on Design and Development of Internal Combustion Engines and Associated Equipment and Accessories.
(F) The Testing, Analysis, and Development of Materials, Metallic or Non-Metallic, including Plastics.
(G) Work on the Development of Instruments or on Small Mechanical and Electrical Devices. A few posts require specialised knowledge of Applied Electronics.
(H) Work on the Development of Armament and Associated Equipment, preferably with experience of its Installation in Aircraft.
(J) Aircraft Installation Work, either in Power Plants, Instruments, or Electrical Equipment.
(K) Persons without particular experience in the categories specified above, but with general experience in Light Mechanical and Electrical Engineering, either as research workers or as design and development engineers, are invited to apply for these posts.

Requests for application forms may be made by POSTCARD addressed to the MINISTRY of LABOUR and NATIONAL SERVICE, CENTRAL (TECHNICAL and SCIENTIFIC) REGISTER, ROOM 475, ALEXANDRA HOUSE, KINGSWAY, LONDON, W.C.2. Completed forms should be returned not later than 23rd October, 1943. The grade and category of the post for which application is being made must be inserted in the top right-hand corner of the form, e.g., "Technical Officer (D)."

Applications will not be acknowledged, but every applicant will be informed in due course of the result of his application. 8434

SITUATIONS OPEN

IMPORTANT

Advertisers in Situations Open Column should make themselves acquainted with the terms of

STATUTORY RULES & ORDERS 1941 No. 2069

RESTRICTION ON ENGAGEMENT ORDER

WANTED, Trained METALLURGIST, with experience of all Processes in the Production of Alloy Steel Billets by Electric Arc Furnace Method, and with a sound knowledge of the Metallography of these Steels. Please state salary, experience, &c.—Address, P6366, The Engineer Office. P6366 A

ADVERTISERS, Engaged in the Manufacture and Processing of Chemicals, REQUIRE a GENERAL WORKS MANAGER to Supervise and Control the Operation and Production of Two Factories situated in the Midlands. The position offered is permanent and the post-war prospects are considered to be excellent. Applicants between the ages of 35 and 45 should be fully experienced, accustomed to responsibility, and good disciplinarians. First-class references are essential, and the salary will be commensurate to the position.—Applications, which should give fullest particulars, to be addressed 8394, The Engineer Office. 8394 A

AN ENGINEERING COMPANY of International repute, with six plants, REQUIRE the SERVICES of a COMMERCIAL MANAGER, whose duties would cover the Selling, Buying and Stores Organisation of the Group. Applicants should not be more than 50 years of age, have had selling experience as early training, but with wide experience of Sales Management in recent years. The position will carry an ample salary and all applications will be treated in confidence.—Box 9, Strand House, London, W.C.2. 8403 A

APPLICATIONS are INVITED for a SECRETARY to a Trade Association with office in London, whose membership comprises firms representing important branches of the engineering industry. It is envisaged that the successful applicant will have engineering knowledge, with Secretarial, Accounting, or Statistical experience; of good address and able to make approaches on a high level of authority. Replies, giving full details of experience, age, and salary expected, will be treated in strict confidence.—Address, 8421, The Engineer Office. 8421 A

ASSISTANT ENGINEER REQUIRED for the Government of Northern Rhodesia Public Works Department for one tour of 24 to 36 months. Salary £450-£25-£600-£30-£840 a year. Initial salary according to qualifications and experience. Free passages and quarters. Candidates should be Corporate Members of the Institution of Civil Engineers or hold an equivalent degree and have had practical experience of General Engineering.—Write, stating age and full particulars of qualifications and experience, to the CENTRAL (TECHNICAL and SCIENTIFIC) REGISTER, MINISTRY of LABOUR and NATIONAL SERVICE, Alexandra House, Kingsway, London, W.C.2, quoting reference E.697. 8429 A

EXECUTIVE ENGINEERS, GRADE IV, REQUIRED for the Nigerian Government Public Works Department for two tours, each of 12 to 24 months, with possibility of ultimate appointment to the permanent and pensionable establishment. Salary £475, rising to £840 a year and, subject to promotion to a vacancy, to £1000 a year. Separation allowance for married men is £80 on salary of £475. Free quarters and passages. Candidates must hold a University Degree in Civil Engineering or have passed Sections A and B of the A.M.I.C.E. examination or have equivalent qualifications, and should preferably have had two years' experience on Engineering Works of importance.—Write, stating age and full particulars of qualifications and experience, to the MINISTRY of LABOUR and NATIONAL SERVICE, CENTRAL (TECHNICAL and SCIENTIFIC) REGISTER, Alexandra House, Kingsway, London, W.C.2, and quoting the reference E.773. 8430 A

EXECUTIVE ENGINEER REQUIRED for the Sierra Leone Government Public Works Department for one tour of 12 to 24 months in the first instance. Salary in scale £600 by £30 to £840 by £40 to £1000 a year. Initial salary according to age, qualifications, and experience. Free passages and quarters. Candidates must be fully qualified Civil Engineers, competent to undertake the Design and Supervision of the Construction of Buildings, Bridges, and other Engineering Structures. Good experience on actual construction work and control of labour is essential.—Write, stating age and full particulars of qualifications and experience, to MINISTRY of LABOUR and NATIONAL SERVICE, CENTRAL (TECHNICAL and SCIENTIFIC) REGISTER, Alexandra House, Kingsway, London, W.C.2, quoting reference No. E.774. 8432 A

OLD-ESTABLISHED COMPANY (Non-ferrous Metals) invite APPLICATION VACANCY BRANCH WAREHOUSE MANAGER. Must be energetic and good organiser of labour. Experience of trade not essential. Fullest details, strict confidence.—Address, 8395, The Engineer Office. 8395 A

PRODUCTION MANAGER.—APPLICATIONS are INVITED for the POSITION of PRODUCTION MANAGER at a large Aero-engine Factory. The appointment carries full control of the production side of the factory. A specialist knowledge of Modern Machine Tool Plant and Equipment engaged on producing Aero-engine Components of a high grade and over a wide range is required. Previous experience in the capacity of Production Manager in a similar organisation is essential. Excellent opportunity for the right man. Salary will be commensurate with qualifications.—Address, 8416, The Engineer Office. 8416 A

SITUATIONS OPEN

TECHNICAL AUTHOR REQUIRED, Some Practical Engineering experience an advantage. Important work. Good prospects for right type. Details age, experience, salary expected.—Address, 8443, The Engineer Office. 8443 A

THE DIRECTORS of an ENGINEERING GROUP are interested in obtaining the SERVICES of a highly qualified ENGINEER with first-class General Management experience, to Take Executive Control of one of their largest Plants. This is a permanent position, with a high initial salary, and the prospects are excellent. Applications are invited from men up to age 50, who have energy and initiative and are well versed in modern management.—Address applications, giving fullest particulars, 8442, The Engineer Office. 8442 A

WATERWORKS ENGINEER REQUIRED for the Nigerian Government Public Works Department for two tours, each of 12 to 24 months, with prospect of ultimate appointment to the permanent and pensionable establishment. Salary £690-£30-£840-£40-£1000 a year. The initial salary would be fixed at a point within this scale according to qualifications and experience. Free quarters and passages. Candidates must be Corporate Members of the Institution of Civil Engineers or hold an Engineering Degree recognised as granting exemption from Sections A and B of the A.M.I.C.E. examination and have had considerable practical experience in Waterworks Maintenance, Construction, and preferably in Investigations. They must be competent to Design Details and to Take Charge of the Construction of Waterworks Schemes involving Dams, Pumping and Purification Plant and Distribution Systems, &c.—Write, stating age and full particulars of qualifications and experience, to the MINISTRY of LABOUR and NATIONAL SERVICE, CENTRAL (TECHNICAL and SCIENTIFIC) REGISTER, Alexandra House, Kingsway, London, W.C.2, quoting the reference number E.771. 8431 A

SITUATIONS WANTED

ASSISTANT CHIEF DRAUGHTSMAN and DESIGNER (41), A.M.I. Struct. E., in charge of large D.O., 20 years' first-rate experience in all classes of heavy bridge and structural work, DESIRES CHANGE, Birmingham Dist. preferred. Similar or higher position wanted with post-war prospects.—Address, P6372, The Engineer Office. P6372 B

ASSISTANT SURVEYOR, for 20 Years with leading con. engrs. and surveyors on owners' and underwriters' work, conversions, &c., SEEKS similar POSITION, or with Ship Repairers. Draughtsman, energetic, excellent ref. Mod. sal.; age 51.—Address, P6367, The Engineer Office. P6367 B

CAMBRIDGE and LONDON GRADUATE, liberal works experience, subsequently devising and planning new schemes, SEEKS POST, developing managerial ability.—Address, P6375, The Engineer Office. P6375 B

ENGINEER, 23 Years' Experience, Thoroughly conversant all classes of machine tool operations, tool setting, tool making, fitting, designing, &c., SEEKS RESPONSIBLE POSITION, London.—Address, P6374, The Engineer Office. P6374 B

ENGINEER (46) DESIRES POST with Reputable Firm as Representative or Agent. Wide experience, sales management, buying, production engineering, and progress; workshop and drawing-office training.—Address, P6379, The Engineer Office. P6379 B

ENGINEER (43), Sound Technical Training, five years' apprenticeship, twelve years practical, including supervision, eleven years drawing-office, with five in charge jig and tool design, SEEKS EXECUTIVE POSITION; knowledge of light and heavy engineering.—Address, 8438, The Engineer Office. 8438 B

ENGINEER, Well-educated, Apprenticeship, D.O. and works experience, accustomed responsibility, presently assistant to consulting engineer (contracts terminated), WISHES APPOINTMENT.—Address, P6371, The Engineer Office. P6371 B

ENGINEER (40) Exempt, with Maintenance hydraulic, air, welding, general machine shop, considerable design new plant and buildings in factory employing 1500, REQUIRES similar POST in Midlands.—Address, P6368, The Engineer Office. P6368 B

ENGINEER, IMMEDIATELY FREE (41), experience covers works and office control, technical, D.O., contracts, light machining, welding, sheet metal, &c.—Address, P6369, The Engineer Office. P6369 B

ENGINEER (Dr.-Ing.), Industrial and Mechanical, age 43, wide experience abroad, technical and commercial ability, very progressive, good organiser, experience in overseas developments, group production and co-ordination, planning of new industries, training in great electrical and industrial concerns, perfect knowledge of five modern languages, DISPOSED TAKE CHARGE or CONTROL ORGANISATIONS ABROAD. London area preferred.—Address, P6354, The Engineer Office. P6354 B

MECHANICAL ENGINEER (Technical and practical), age 46, REQUIRES MANAGERIAL POSITION. Positions held: production manager, chief engineer, chief designer, 25 years' experience controlling all departments, manufacturing automobiles, commercial vehicles, guns, &c. Speciality, current production, post-war designs, and development. Contract terminates December, release obtainable in interim.—Address, 8428, The Engineer Office. 8428 B

SITUATIONS WANTED

MAN, Exempt, WANTS Any WORK Abroad. Pay own exps. and fare abroad. Depos £100, more for superior post, as assurance of g faith.—Address, P6378, The Engineer Office. P6378 B

MECHANICAL ENGINEER, Age 32, Experience, plant and motor vehicle maintenance fitting, turning, welding, and electrical instal tion, Higher National Certificate and Engi ment, DESIRES POSITION as Assistant Engi neer. Salary secondary consideration to positi where advancement may be expected on pro ability.—Address, P6352, The Engineer Office. P6352 B

POST-WAR DEVELOPMENT.—ENGINEER SALESMAN (qualified), with extensive connection in modern treatment plants for sewage, water, and trade waste, DESIRES CON TACT with progressive ENGINEERING CO CERN.—Address, P6377, The Engineer Office. P6377 B

PROGRESSIVE ENGINEER (44), SEEKS POSITION of RESPONSIBILITY, M. I. W., experienced all metals, electric and gas, repair work. D.O. and machine design tra and knowledge of metallurgy, planning and mercial ability. Merseyside preferred. Ref under consideration.—Address, P6373, The En neer Office. P6373 B

STRUCTURAL and CIVIL ENG. COMPETENT DESIGNER and ESTIMATOR, exceptionally wide successful exp. in surv ing and execution large contracts, founds., st framed multi-storey, power stations, cinem light roof, indust. bldgs., and conveyors, fir class organiser and leader, age 37, sal. £6 REQS. TECHNICAL and MAN. or CONSULT TIVE POST.—Address, P6336, The Engi Office. P6336 B

WORKS ENGINEER, Free (49), Electrical a mechanical experience, boilers, generato transformers, distribution, motors, press machine tools, buildings, good references, SEE POSITION with post-war prospects.—Wr Box D805, Willings, 133, Moorgate, E.C.2. 8402 B

PATENTS

THE PROPRIETOR of BRITISH PATE No. 450,995, entitled "Gyrating Screen DESIRES to ENTER into ARRANGEMENTS LICENCE or otherwise for ensuring the practi working of the patent in Great Britain Inquiries to SINGER, STERN and CARLBER Steger Building, Chicago, 4, Illinois, U.S.A. 8396 B

THE PROPRIETORS of the PATENT 343,066, for "Improvements in or relati to Fittings for Reinforced Tubing," are DESI OUS of ENTERING into ARRANGEMENTS way of LICENCE and otherwise on reasona terms for the purpose of EXPLOITING the sa and ensuring its full development and practi working in this country.—All communicati should be addressed in the first instance Haseltine, Lake and Co., 28, Southamp Buildings, Chancery Lane, London, W.C.2. 8435 B

MACHINERY, &c., WANTED

WANTED, UNIVERSAL CRAMP FOLDI with swing beam, 48in. by 14-gau Particulars.—Address, 8444, The Engineer Off 8444 B

WANTED, ONE Abrasive Wheel CUTTIN OFF MACHINE, suitable for taking 12in. dia. wheel, 1¼in. bore. Licence No. 1 Particulars.—Address, 8423, The Engineer Off 8423 B

WANTED, Two-Column HAND SCRE PRESS with max. between the colum max. daylight, screw thread and operated crank handle wheel and bevelled gears. Lice No. 151. Particulars.—Address, 8424, The E neer Office. 8424 B

WANTED, 10ft./12ft. Long BENDING ROLL to take up to ¾in. plate. Particulars Address, 8426, The Engineer Office. 8426 B

WANTED, 2 Single-ended PUNCHING M CHINES, to punch ¾in. hole through ¾ thick. Licence No. 151. Particulars.—Addre 8417, The Engineer Office. 8417 B

ALFRED HERBERT, Ltd., Coventry, P BEST PRICES FOR SECOND-HA MACHINE TOOLS in good condition by fir class makers.
Write, wire, or 'phone, and our representati will call. Authorised Dealer's Certificate No. 'Phone: 88781 (20 lines), Coventry; Te grams: "Lathe, Telox, Coventry." 1008 B

We are licensed by the Machine Tool Control for the purchase of all classes of Machine Tools, and we offer good prices for surplus Machinery in any quantities, large or small.
(Machine Tool Control Licence No. 172.)

F. J. EDWARDS, LTD.
359, EUSTON ROAD, LONDON, N.W.1
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For continuation of Small Advertisements see page 4

A Seven-Day Journal

"Midget" Submarines Attack the "Tirpitz"

On Monday evening, October 11th, an official statement issued by the Admiralty made known the fact that His Majesty's "midget" submarines had carried out a successful attack on main units of the German battle fleet in their protected anchorages in Alten Fjord, in Northern Norway. Damage was inflicted on the battleship "Tirpitz." The attack was made on Wednesday, September 22nd. Air photographs which were taken after the attack show the "Tirpitz," which had not moved from her anchorage, surrounded by thick oil, which covered the fjord where she lay and extended over a distance of more than 2 miles from her berth. The photographs also show a number of small unidentified craft alongside the battleship, which are possibly repair ships or ships to provide power and light. Personnel who took part in the operation report that on September 22nd, while still in the immediate vicinity of the anchorage, they heard a series of heavy detonations at the time expected for units to be attacking. Three of His Majesty's "midget" submarines have so far not returned from these operations, and must be presumed lost; but, in view of the German claim of prisoners taken, it is not unlikely that some of the personnel of these vessels are in the enemy's hands. It may be recalled that Alten Fjord, in which the "Tirpitz" lay, is some 1000 miles from the nearest British base. The task set for the "midget" submarines was a formidable one. They had to penetrate the highly defended base and to pass through minefields guarding the approaches to the anchorages. After negotiating intricate fjords, always vigilantly patrolled by the enemy, they had to carry out the attack in strongly protected and confined waters where the ships were moored. To regain their base the same obstacles had to be overcome.

The Late Sir Guy Granet

Railway engineers will have learned with regret of the death, on Monday, October 11th, at his home, Burleigh Court, near Stroud, Gloucestershire, of Sir Guy Granet. Sir Guy was approaching his seventy-sixth birthday. He will be remembered for the work he did in connection with the organisation and administra- of British railways in peace and in war. A former manager of the old Midland Railway, he served for some years as chairman of the London, Midland and Scottish Railway, and during the last war was Deputy Director of Military Railways at the War Office. William Guy Granet was educated at Rugby and at Balliol College, Oxford, was called to the Bar, and in 1909 became Secretary of the Railway Companies' Association. Five years later he was appointed assistant general manager of the Midland Railway Company under Mr. John Mathieson. In 1906 he became general manager, a position which he continued to hold with distinction until 1918, when he retired. During the last war Sir Guy, who was knighted in 1911 and was awarded the G.B.E. in 1923, occupied many Government positions. In 1915 he was Controller of Import Restrictions, and the following year was Deputy Director of Military Railways at the War Office. In 1917 he was appointed Director-General of Movements and Railways and Member of the Army Council, and in 1918 Chairman of the British and Allied Provisions Commission and the Representative in Canada and the United States of the Ministry of Food. In 1921 and 1922 Sir Guy served on the National Economy (Geddes) Committee, and from 1924 until 1927 was chairman of the London, Midland and Scottish Railway Company. This period covered the difficult post-war years and the amalgamation of British railways under the Railway Acts of 1921. In 1933 he was Chairman of the Railway Commission which went to South Africa to report on the Union's railway system. After his retirement from the L.M.S. he continued to occupy a seat on the board and was also a director of the Central Argentine Railways. He was also a director of several banks and financial and industrial concerns, including Associated Electrical Industries, Ltd., and *The Times* Publishing Company. Sir Guy will be remembered as a man of firm decisions and a charm of personality which endeared him to many friends.

Transport in Glasgow

In the course of an address delivered to the Glasgow Publicity Club, on Friday, October 8th, Mr. E. R. L. Fitzpayne, the general manager of the Glasgow Corporation Transport Department, dealt with some of the problems with which road transport in Glasgow is faced. He stated that the traffic had consistently increased since the beginning of the war, while the mileage run had decreased. Last year, 725,000,000 passengers were carried, which was 73,000,000 more than the number carried in the period 1938–39, while 8,500,000 fewer miles were run. There are indications that a saturation point in the transport scheme has been reached and that the undertaking will not be able to deal with any more passengers unless it is possible to put more vehicles on the road. Ultimately it is expected that special consideration will be given to war workers. The policy of sending women south when they were required for transport was unsound, as the greatest problem in Glasgow was the supply of good-class female labour. Some 60 per cent. of the female staff were married women, many of them with young families. Absenteeism and sickness had reached alarming proportions, which might increase with the coming winter. During the month of July 135,000 hours were lost by absenteeism and sickness by conductresses, which was equivalent to a staff of 650 women. As many as 310 cars had had to be withdrawn from service in one day because of staff shortage, with the result that a five minutes' service had become a twenty-five minutes' service. Despite these drawbacks, changes in transport arrangements had led to a reduction in the number of delays and accidents. Glasgow could be proud of the fact that its buses were operating on oil produced in the Scottish shale oilfields. This was mixed with creosote obtained from the Corporation's Gas Department. After exhaustive experiments, which had been carried out by both the Gas and the Transport Departments, some 3000 gallons of creosote were being used each week, which represented 10 per cent. of the total oil fuel used.

New Atlantic Bases

Speaking in the House of Commons on Tuesday evening, October 12th, the Prime Minister, Mr. Winston Churchill, announced that, in response to a request of the British Government, the Portuguese Government had agreed to accord to Great Britain facilities in the Azores which would enable merchant shipping to be given better protection on the Atlantic routes. The agreement, Mr. Churchill said, arose out of the treaty which was signed by this country and Portugal in the year 1373 between His Majesty King Edward III and King Ferdinand and Queen Eleanor of Portugal. That treaty had been reinforced by later treaties between 1386 and 1899, and by the Treaties of Arbitration which were concluded with Portugal in 1904 and 1914. The conditions governing the use of these facilities in the Azores are defined, and British assistance will be given in furnishing essential material and supplies to the Portuguese armed forces and the maintenance of Portuguese national authority. The agreement, it is stated, is of a temporary nature only and it in no way prejudices the maintenance of Portuguese sovereignty over Portuguese territory. All British forces will be withdrawn from the Azores at the end of hostilities. In reply to a message from Mr. Anthony Eden, the Foreign Secretary, expressing the conviction that the facilities granted will greatly contribute to the effective defence of our shipping, and thus prove an important factor in shortening the war, Dr. Salazar, the Portuguese Prime Minister, says that he trusts that this new proof of Portugal's loyalty to her traditions will fortify the secular alliance and enhance the close and friendly relations which have so long subsisted between Portugal and Great Britain. From America it is announced that the President, Mr. Roosevelt, has indicated that the United States would share the use of the bases with Britain and that in an emergency other nations at war with the Axis could make use of them. It was revealed that the decision to seek the use of these bases was taken at the Washington Conference between Mr. Churchill and President Roosevelt last May.

War Construction in U.S.A.

More than 80 per cent. of the plant construction for the United States war programme was completed by the middle of this year, states *The Guaranty Survey*, published by the Guaranty Trust Company, of New York, as against 61 per cent. at the beginning of the year and 34 per cent. at the middle of 1942, according to the War Production Board. Synthetic rubber facilities were 61 per cent. complete on June 30th, 1943, as against only 3 per cent. a year ago. The most rapid progress has been made in the construction of plants to produce finished munitions, such as guns, combat vehicles, aircraft, ships, and ammunition, which are 95 per cent. complete. Altogether, about 12,038 million dollars of the total allocations of 14,582 million dollars was spent up to the end of June. Both the number and the amount of War Department contracts outstanding in March of this year were ten times as large as those at the end of the last war, according to the Ordnance Department. As compared with the 24,000 contracts with a dollar volume of 7·5 billion dollars at the close of World War I, there were in March, 1943, about 240,000 contracts amounting to approximately 75 billion dollars. These figures were made public in connection with a study of the problem of terminating war contracts, a question that is recognised as being of vital importance to industry. Producers of war equipment are displaying more caution than formerly in purchasing materials in excess of early needs. The alteration is attributed chiefly to uncertainty as to possible cut-backs in military requirements due to recent Allied successes on the fighting fronts. The greater conservatism in forward buying is regarded as a change for the better.

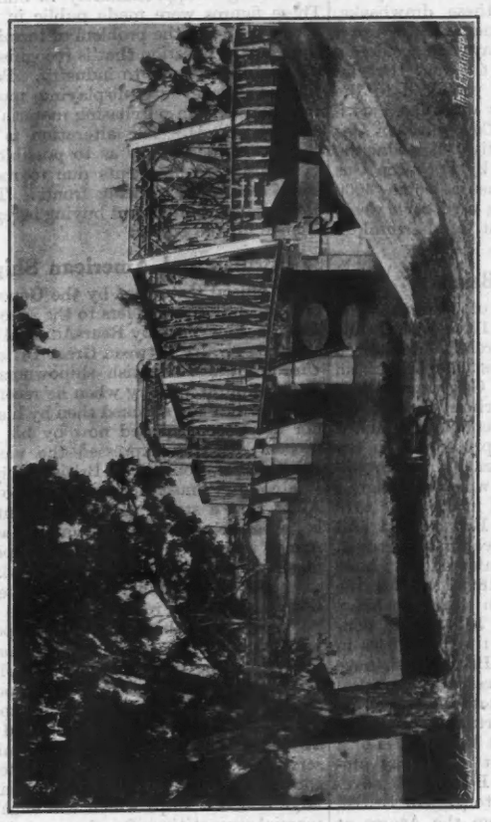
British and American Shipping

An official statement by the General Council of British Shipping refers to the speech recently made in New York by Rear-Admiral Vickery on shipping rivalry between Great Britain and the United States. British shipowners who met Rear-Admiral Vickery when he recently visited London were not shocked then by his bluntness, nor are they surprised now by his New York speech. Having expressed the view through the General Council of British Shipping that this country must not be afraid to say to its Allies that a strong British Mercantile Marine is just as necessary to this country as its Navy, Army, and Air Force, British shipowners are not likely themselves to be afraid when an Ally says the same thing. They have sufficient faith in American realism to believe that it will be recognised that, however important the possession of an adequate Merchant Marine may be to the United States, to Britain it is a vital necessity. This country's policy is to co-operate with America in the spirit of the Atlantic Charter, so that the world may have at its disposal efficient and economic shipping services. Admiral Vickery also stated that this country has been concentrating on well-built large and fast ships which will engage in commercial competition after the war, while America has been putting more emphasis on turning out such strictly emergency vessels as "Liberty" ships. The facts are that the United States and British Governments agreed that America was to be the predominant builder of cargo ships and Britain was to concentrate on naval craft.

SOME AUSTRALIAN BRIDGES

(For description see opposite page)

CONSTRUCTION OF BRIDGE OVER LONG BAY, SYDNEY
SYDNEY HARBOUR BRIDGE



MILDURA BRIDGE OVER RIVER MURRAY
BRIDGE ON HORNSBROOK HIGHWAY, QUEENSLAND

Engineers and the British Empire

By Professor MIDDLETON SMITH, M.Sc., M.I. Mech. E., LLD.

No. XV—(*Continued from page 280, October 8th*)

Sydney and Newcastle

THE bulk of the trade of New South Wales is directed to Sydney, which has a beautiful and valuable harbour. The majority of the ships engaged in the oversea and interstate trade of the Commonwealth call at one or other of the ports of this state.

The first small settlement at Sydney, in 1728, was the beginning of what is now a city containing over 1¼ million inhabitants and the senior state in the Commonwealth. Until 1825 its boundaries included the whole continent of Australia and Tasmania. For many years New Zealand was a dependency. It was not only the splendid natural harbour that attracted ships and settlers, but the healthy climate and the obvious economic advantages of the surrounding country.

With regard to tonnage, Sydney ranked as one of the leading ports in the Empire, the figures for 1935–36 being 10,479,774 net tonnage of vessels entered, the average rate per ton of shipping entered being 5·11d., as compared with 11·28d. for the Port of London in the same year.

It has a safe entrance and affords good protection under all weather conditions. Its area is about 22 square miles, half of which carries a depth of 30ft. or more at low water ordinary spring tide. The foreshores extend 188 miles—they are irregular—so there is ample room for extensive wharfage. The wharves are near to the business centre of the city, about 4 or 5 miles from the heads. There are 78,031ft. of wharfage, excluding private lighter and ferry berths.

There are silos with a capacity of 7,500,000 bushels for storing wheat in bulk. The grain can be delivered into the holds of vessels at the rate of 1400 tons an hour. The storage and handling facilities for other cargo, such as wool, are excellent. Some forty-eight vessels are certificated to carry nearly 39,000 passengers across the harbour. The wharves are on the southern shore of the port; the northern shore is devoted mainly to residential sites.

In 1939–40 Sir Alexander Gibb and Partners, at the request of the Commonwealth Government, reported on the most suitable location for and estimated the cost of a dry dock to accommodate capital ships and large merchant vessels. This London firm was subsequently appointed consulting engineers for the construction of the dry dock. Work commenced in 1940 is proceeding.

Newcastle Harbour (Port Hunter) possesses a harbour in the course of the Hunter River. It ranks as the third port in Australia. The area used by shipping is about 570 acres, excluding the entrance to the harbour and the inner basin, which together cover an area of 672 acres. It is a sufficiently land-locked harbour to provide safety for vessels in all kinds of weather. Breakwaters have been erected to improve the entrance and to prevent sand from the ocean beaches entering the harbour. Mainly a coal-handling port, it serves the iron and steel industrial plants, and ships wool, wheat, frozen meat, and timber. The general cargo wharves are connected with the main railway system. The total wharfage accommodation is 21,597ft. There is a terminal elevator for handling bulk wheat.

Port Kembla Harbour has an area of 330 acres, of which 239 acres have a minimum depth of 24ft. As it is adjacent to the coal-fields, and has rapidly developed as a centre for secondary industries, its trade is important and a great future for the port is predicted.

The Maritime Services Board of New South Wales controls the ports of Sydney, Newcastle, and thirty-one outports of the state. The Board consists of five commissioners, three of whom give their whole time to its work and two give part-time service and represent commercial and shipping interests.

In general terms it may be said that the great majority of the vessels visiting Australian ports are under the British flag, the deep-sea trade with the Empire being controlled by shipowners in Britain and the interstate trade by Australian owners.

HIGHWAY BRIDGE, QUEENSLAND

Brisbane Harbour Works

Work at Petrie was carried out in such a manner as to cause a minimum of disturbance to shipping using the wharves and to fit in with the operations of the bridge contractors. The work, which included widening the river, was carried out by the Departments of Harbours and Marine, under the supervision of the engineer, Mr. D. Fison, A.M.I.E., Australia.

It was estimated that some 838,000 tons of material would have to be removed by dredging at a cost of 1s. 6d. per ton, but the average cost was well below the estimate. The work improved the discharge of flood waters and increased the visibility for ships around Kangaroo Point. The values of river frontages were very much improved.

The total amount of material excavated up to the end of August, 1939, was 173,000 cubic yards. In the area behind the upper berth, where temporary piers were erected, the roadway was widened and the cliff cut back. Work which improved the access and provided additional accommodation for handling cargoes was completed.

The Port of Mackay, Queensland

Captain Cook cruised along the coastline of Queensland (1770) and made a reference in his famous journal to the district now called Mackay. A party of land seekers, led by a twenty-one-year-old Scot, blazed a pioneer trail over the mountains (1860) and entered thereto unexplored territory which included the place now named Mackay. He finally created a cattle station and piloted the first small vessel up the Pioneer River that brought stores (1862). Soon afterwards he charted the river, which was gazetted a port of entry by the Crown Lands Office.

Unfortunately, the bed of the Pioneer River, some 25 miles from its mouth, is 120ft. higher than its bed at the point where it debouches into the sea, and the bed of the channel of the river is some 6ft. above low water spring level of the sea, so that the lower reaches of the river are practically dry at low water. Moreover, owing to decomposing granite in its 540 square miles drainage area, the river is choked with sand from its source to its mouth.

The success of an almost casual experimental planting of sugar canes (1865) finally produced sugar worth £2,300,000 annually, and by 1938 nearly 3 million tons of sugar had been produced in the Mackay district, causing a rapid increase in population. Small wonder that there grew, with increasing vigour, an agitation to obtain deep-water shipping facilities.

Sir John Coode reported (1887) in favour of a scheme involving an expenditure of £600,000 in the mainland—Flat Top Island area—but the cost was greater than could be accepted. Subsequently, several other schemes were planned by engineers. In 1911 the Flat Top scheme was commenced; work continued for some months and then the scheme was abandoned. Next a river improvement plan, including a director wall, was started. It cost about £200,000, provided little, if any, improvement, and was also abandoned after some years of work. The Flat Top scheme was favoured in another report, but not accepted by the Harbours and Marine Department.

Finally, after much investigation by Australian engineers, the proposals, first suggested by Engineer C. W. Darley (1897), for a deep-water port on the northern coast of the river were elaborated and a site 2½ miles north of the river was selected. Plans and specifications were prepared by D. Fison, Chief Engineer, Harbours and Marine Department, on the general designs suggested by one of the consulting engineers, G. A. Lee.

An enclosed harbour has been built, comprising an area of 185 acres. The whole scheme cost about one million pounds. The harbour is protected by a southern and a northern breakwater, respectively 4240ft. and 3315ft. long. These are of rubble stone with a concrete capping. A concrete pier provides wharfage; it is 766ft. long and 138ft. wide. There are sheds, conveyors, and other modern equipment for sugar and general cargo.

It is the deepest harbour in Queensland, with 30ft. at low water spring tides at entrance, which is 600ft. wide. It is 3½ miles from the city and a railway and a fine bitumen road make transport easy. Ample stone was available within a mile of the site.

An official statement gives the names of ten engineers who had submitted plans at different dates. It adds: "Most of the schemes revolved around the central idea of that incorporated in the plans submitted by Sir John Coode."

Tasmanian Ports

Hobart's deep-water harbour, from the entrance to Government House Point, 14 miles from the ocean, is 25,500 acres in area. Dredging is unnecessary; there is a width of at least 2 miles free from any obstruction; the largest liners berth at the wharves without the aid of tugs. Low-water depth at the entrance is 48ft. and 36ft. to 60ft. at the wharves and piers, which are situated at the foot of the city streets. The Denison Canal links the ocean with the inland water system of the Derwent.

All the piers and wharves are built of Tasmanian timber with the exception of Elizabeth Street pier, which is of concrete. Shipping aggregating 1,700,000 tons called at the port in 1935–36, the value of imports and exports being about £8 millions. H.M.S. "Hood" berthed at Hobart under her own steam.

Launceston, situated on both banks of the Tamar, is only 277 miles from Melbourne. It is 42 miles from the sea up the winding river and is reached by steamers of 4000 tons. More than £5,000,000 worth of goods pass over the wharves annually. These and smaller ports are managed by ten Harbour Trusts.

Sydney Harbour Bridge

Although the city was founded in 1788, the need for a bridge across the harbour had been realised for more than a century. Ferries were an unsatisfactory solution of the traffic problem. In 1924 tenders were called for; work on the structure commenced in November, 1924, and was completed in March, 1932. It achieved world fame and great publicity when completed. It may be of interest to record some of the chief features.

The length of the main arch span is 1650ft.; the total length of the bridge from abutment to abutment is 3770ft. The width of the bridge across the deck of the arch span is 160ft.; the width between the main arch trusses is 98½ft. The bridge carries a central roadway 57ft. wide, four railway tracks, each 4ft. 8½in. in gauge, and two footways, each 10ft. wide.

There is clear headroom for shipping under the deck of the arch span of 170ft. The height from water level to the top of the arch steel work is 440ft.

The total weight of steel in the bridge is 53,000 tons; the steel in the arch span only weighs 38,000 tons. The approximate cost of the bridge was £4,250,000. It will be remembered that the English contractors were heavily penalised, as they did not anticipate the considerable depreciation in the value of Australian as compared with British currency when they contracted to build the bridge.

The bridge was designed in London by Ralph Freeman to a specification drawn up by the late Dr. J. J. C. Bradfield. Dorman, Long and Co., Ltd., made the parts in Middlesbrough and Darlington. After they were shipped to the site, some 11,000 miles distant, the bridge was put together without a hitch. The rivets were made in Australia, large numbers of Australian workmen assembled it in position, and some of the finishing work was done by local firms. The precision essential in the design, manufacture, and erection is worthy of emphasis. Aberdeen quarrymen went out to Sydney to provide the granite-faced pylons at the ends and the granite piers supporting the approach spans with Australian granite, and so, by a splendidly combined effort made in the old country and the Commonwealth, Sydney obtained the bridge which earlier residents had hoped for in vain.

The Story Bridge, Brisbane

This city, capital of the state of Queensland, is situated on both sides of the River Brisbane. While the bridge work was being erected the harbour improvements were in progress.

The total cost of the bridge was about £1,600,000, but this was reduced by a grant of £800,000 from the unemployed relief fund. A total of about 340 men were employed on the average by the contractors and at the steel fabricating shops, apart from the engineering staff and incidental employees of the Bridge Board. The consulting engineer was J. J. C. Bradfield, C.M.G., D.Sc., M. Inst. C.E., &c.; the supervising engineer was M. A. Holt, B.E., B.Sc.

The bridge was named after Mr. J. D. Story, a prominent worker in Government service, who had helped a great deal to form the State Bureau of Industry, which controls much of the engineering work done in Queensland.

Before the bridge was built there were two smaller bridges across the river, but traffic was congested and they were not so conveniently situated. Moreover, it was desired to make movement easier for the considerable through traffic along the eastern coast of the Dominion.

The span of the cantilever bridge is 924ft. between the centre lines of the main piers. The full length of the bridge is 1463ft., which is only 187ft. less than that of the more famous Sydney bridge. The steel was supplied by the Broken Hill Proprietary and the Australian iron and steel firms. Some 11,800 tons of steel work were fabricated near the site of the bridge.

The decision to build this bridge at Kangaroo Point was influenced by the desire to provide employment. The Bridge Board and the consulting engineer, Dr. J. J. C. Bradfield, recommended the construction of the cantilever bridge, with a channel of 924ft., 100ft. above high-water level, and 60ft. wide between trusses, the roadway to be 40ft. wide with two 10ft. footways, but the bridge to be designed to carry a 60ft. roadway and two 10ft. footways on the cantilevered ends of the cross girders. The latter provision allows the roadway to be widened to 60ft. and of footways being carried outside, should increased traffic require the additions. The Queensland Government adopted these recommendations in 1934.

A double-deck low-level bridge was practicable, giving a better distribution of traffic, but it would have completely closed the river. Apart from shipping considerations, it would be vulnerable to a very large flood. The high-level bridge not only reduces traffic congestion, but allows the continued use of the river for large ships and is safe in case of heavy floods.

The consulting engineer considered that the cantilever bridge would be more suitable than a suspension bridge; the span of 924ft. is too long for a truss bridge. He wrote: "The cantilever bridge, with its lofty towers and powerful river arms supporting the level span over the centre of the waterway, its back spans and anchor piers linking the bridge with either shore, will best harmonise with the picturesque and rugged beauty of Brisbane's skyline."

A Queensland firm secured the contract, engaging a specialist, Mr. J. R. Wilson, of the Dominion Bridge Company, Canada, who had had experience in the erection of a large bridge of the same type. The design and construction of the bridge has met with general approval.

The Bridge at Hobart

A new type of bridge is being erected at Hobart to span the River Derwent. The bridge will comprise four approach spans of ordinary design, built out into the river until water deep enough to permit the passage of shipping to the upper parts of the Derwent is reached; an opening lift span, 180ft. wide, for the passage of ships; a large abutment carrying the eastern tower of the lift bridge, and to one end of which the floating arch is hinged; and an abutment founded on rocks on the eastern shore to which the other end of the arch is hinged. The main principle of the bridge is that a concrete arch, 3180ft. long, made up of water-tight compartments, and floating horizontally on the water, will form the roadway. Latest advice is that it is likely that the floating portion is now in position, satisfactory progress having been made during the past six months. Numerous difficulties in erection have been encountered, but have been overcome. This bridge will enable water traffic to pass freely to the newsprint mills which are established above Hobart, the site having been selected for its proximity to easy water transport, dense forests, and accessibility of hydro-electric power.

(To be continued)

Sea and Air Transport

At a meeting of the General Council of British Shipping, held at Bury Court, St. Mary Axe, on Friday, October 8th, under the chairmanship of Mr. Philip Runciman, the question of shipowners participating in post-war civil aviation was further discussed. A report was made on the replies to a recently circulated questionnaire, which invited shipowners to express their intentions with regard to the air. Those replies indicated the existence of an immediate and substantial interest on the part of shipowners, and the Council made arrangements for those who desired immediately to take part in air transport to work out their proposals through the appropriate organisations in each category. The Council will remain charged with the duty of submitting to the Government the proposals formulated by the different groups or sections of the industry concerned, and pressing for the right of shipowners as a whole to participate in the development of air transport. It will also be the Council's task to formulate and negotiate with the Government the general conditions governing air transport required to make such participation practicable. The Council has been given to understand that the Government does not intend to reach conclusions as to the form in which the air transport industry in this country can best be organised in the national interest without affording further sufficient opportunity to the shipping industry to state its case.

John Henry Hamilton and the Positive Scavenging Engine

By A. K. BRUCE

No. II—(*Continued from page 282, October 8th*)

HAMILTON'S patent (No. 6015) for the positive scavenging engine was applied for on April 21st, 1890, the complete specification (prepared, like the provisional, by Hamilton himself) being left on January 21st, 1891, and accepted on February 21st, 1891. The title is: "Improvements in Gas or Combustible Vapour Motor Engines," and a notable feature of the specification is the clarity of the description in the provisional, and the precision of the claims in the complete specification. The first four paragraphs in the provisional specification are as follows:—

"In the type of gas or vapour engine wherein the motor piston makes one effective stroke in two revolutions when working at full power, it is usual to retain some of the products of combustion in the cylinder to mix with the incoming charge.

"The object of this invention is the construction of an engine in which these products of combustion shall be replaced by pure air and in which this shall be effected in a simple and mechanically efficient manner.

"For this purpose I connect or cast with the motor piston a larger piston which is formed also to act as a guide block and which reciprocates in a cylinder cast as part of the bed-plate. To the back of this cylinder and concentric and in line with it I bolt the motor cylinder provided with the usual water jacket.

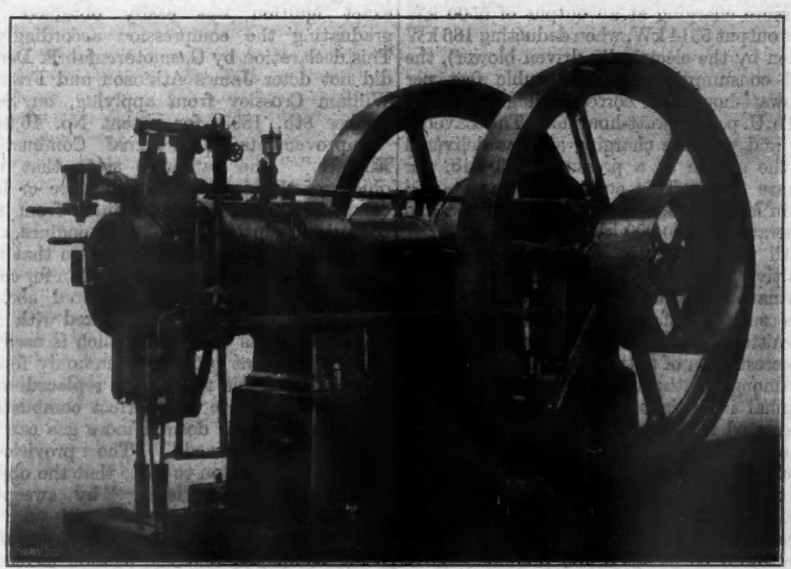
"The space between the two pistons acts as an air pump to slightly compress air and force it through the combustion chamber at the end of the motor cylinder during the latter part of the exhaust stroke."

It is to be observed that nowhere in the provisional or complete specifications does the expression "scavenge" occur, though the inventor refers in both specifications to the pressure at which the air is to be delivered into the combustion chamber. The drawings annexed to the complete specification show the admission valve at the side of the combustion chamber, and the first engine was constructed in this way. For the second engine built by Hamilton with positive scavenge, he adopted the arrangement (never patented but subsequently copied all over the world), whereby the inlet valve in horizontal gas engines was positioned over the exhaust valve on the vertical centre line of the combustion chamber. This particular engine had a single cylinder 13in. (330·19 mm.) bore by 20in. (507·99 mm.) stroke; bore of scavenging cylinder, 17in. (431·79 mm.). The normal speed was approximately 210 r.p.m., the output on producer gas being about 64 B.H.P., B.M.E.P. 90 lb. per square inch (6·32 kilos. per square centimetre). The photograph shows this historic engine, which is still preserved at Sandiacre. As originally built, ignition was by hot tube and timing valve, though Hamilton subsequently fitted the engine—for experimental purposes—with electric ignition using battery and Rhumkorff coil. In its existing condition the engine has tube ignition without a timing valve.

It is opportune to explain here that in applying Hamilton's positive scavenging arrangement to a single-cylinder engine operating on the four-stroke cycle, a piston, forming also a crosshead guide, was employed as the scavenge pump. This scavenge piston was rigidly connected to the working piston in the motor cylinder. After the closing of the admission valve, the usual four-stroke sequence of compression, explosion, expansion, and exhaust followed, but about halfway along the exhaust stroke a second valve (the scavenger valve) lying alongside the mixing valve, was opened by the motion of the layshaft. This valve allowed a current of cool air from the scavenge pump to enter the motor cylinder, the admission and exhaust valve timing being so arranged that during the exhaust stroke the admission valve opened about 105 deg. before inner dead centre, giving an overlap of 145 deg. With this large overlap, both the admission and the exhaust valves were well open on the inner dead centre and the air delivered by the scavenge pump flowed freely through the combustion chamber. In this way the hot residual gases were effectually swept out, the current of air cooling the walls and filling the combustion chamber with clean and comparatively cool air. During the idle stroke of the engine the scavenging charge was simply compressed and expanded in the passages leading up to the mixing and scavenger valves.

Though the standard arrangement was to fit all engines with automatic scavenging valves of leather or of sheet brass, Hamilton built five single-cylinder engines in which the scavenging air valves were mechanically operated from the half speed-shaft. The first of these engines was constructed in 1909 and shipped to Australia, where it is known to have been in use until quite recently.

At the time of the development of the positive scavenging engine, Hamilton was acting as designer to Wells Brothers, Sandiacre, afterwards the Premier Gas Engine Company, Ltd., and it may be noted that in a catalogue issued under date January 1st, 1892 (by Wells Brothers) the following description occurs:—"In these engines the Otto cycle has also been adopted, but the residual products of combustion, instead of being retained to mix with the explosive charge, are expelled and replaced by a charge of pure air, previous to the admission of the gas and air. This results not only in more perfect combustion, but also in less loss of heat to the cylinder walls, and the latter, as well as the piston and valves, are kept in a cooler condition. The pump for forcing the air through the combustion chamber is formed by placing a large piston in front of the motor piston, and as the connecting-rod is centred in this large part of the piston, the latter serves to take the lateral thrust of the connecting-rod, and both the small end bearings of the latter and the slipper have the advantage of being perfectly cool when the engine is working at its full load, and the motor piston is relieved of all the side thrust which exists in other gas engines." At the date of issue of this catalogue the largest engine listed was of 40 I.H.P., speed 160 r.p.m. The description must certainly have been composed by Hamilton, and it will be noted that there is no mention of the word "scavenging." Later, in October, 1895, a further list was issued by Wells Brothers on which was printed the following paragraph:—"Engines constructed with patent positive scavenging arrangement, whereby the products of combustion are expelled and a cool charge of air pumped through the cylinder after each explosion."



HAMILTON'S SECOND SCAVENGING GAS ENGINE

This appears to be the first recorded instance of the use of the expression "positive scavenging."

Hamilton's invention was not patented in foreign countries other than the United States of America—where the patent was allowed to lapse—and great avidity was shown by foreign gas engine builders in copying it. The German copyists were quite frank about the appropriation. Unable to satisfy themselves as to the precise extent of the advantage ensuing from the pressure scavenge of four-cycle gas engines, they visited a power station in which one of Hamilton's engines was at work and found the I.M.E.P. shown on the indicator cards to be far and away higher than anything reached on similar gas with their own engines. They noted how this result was attained, and forthwith adopted the scavenging pump, or, as it was termed by them,

"Spül" pump. Long after the Germans took their first leaf out of Hamilton's book, the Maschinenfabrik Augsburg-Nürnberg applied scavenging and pressure charging to their Nürnberg-built type "D.T.15" double-acting four-cycle gas engines, the largest of the kind ever standardised. With twin-tandem combinations of this description having cylinders 5ft. (1524 mm.) bore by 5ft. (1524 mm.) stroke, speed 94 r.p.m., and a scavenging and pressure charging pressure of 3·5 lb. per square inch, they were able to offer an output of 10,000 B.H.P. Without scavenging and pressure charging the rated output of this engine was 8000 B.H.P. There is a record of tests made during 1928 on a twin-tandem engine of similar type ("D.T.Z 14"), but with cylinders 4ft. 5in. (1346 mm.) bore by 4ft. 7in. (1397 mm.) stroke, speed 91 r.p.m. This engine was installed at Dudelange, Luxemburg, and operated on blast-furnace gas of 112 B.Th.U. per cubic foot. At an output from the generator of 3725 kW, without scavenging and pressure charging the engine the fuel consumption per kilowatt-hour was 129 cubic feet, corresponding to 14,500 B.Th.U. per kilowatt hour. With scavenging and pressure charging at an output of 5500 kW (net output 5314 kW, when deducting 186 kW taken by the electrically driven blower), the fuel consumption was 120 cubic feet per kilowatt-hour net, corresponding to 13,500 B.Th.U. per kilowatt-hour net. The scavenging and pressure charging air was delivered to the engine at a pressure of 3·5 lb. per square inch. This equipment was started up in May, 1926, and at the date of test had generated 21,000,000 kW hours.

All that Hamilton ever got out of his positive scavenging system so far as the Germans and other imitators were concerned was such satisfaction as comes to those altruists who relish what is called the sincerest form of flattery.

Among Continental engineers who, more original in their outlook, were particularly interested in the scavenging of gas engines, mention can be made of Wilhelm von Oechelhäuser and Hugo Junkers. According to the specification of their British patent No. 14,317, applied for on August 8th, 1892, these patentees found that "the gas engines heretofore constructed for producing great power are of a large size, the cost of manufacture is very high, and the working is rendered difficult by too strong heating and frequent spontaneous ignitions. In addition to this, the consumption of gas does not decrease with the size to the extent which it might have been expected." The provisional specification goes on to explain that by the construction described in the patent "the thorough cleansing by the fresh air is due to the admission orifice at one end of the cylinder being opposite to the discharge orifice at the other end, and to the suppression of all deleterious auxiliary spaces which in other two-piston gas engines are uncovered during the combustion between the two engine pistons. . . . The engine space is quite filled with fresh air on the termination of the cleansing, so that the initial temperature of the compression is reduced as much as possible and the occurrence of spontaneous ignition by the hot products of combustion is prevented." Long afterwards, Junkers carried the charging further by proposing to throttle the engine exhaust so that the scavenge pump of his opposed-piston oil engine, having to overcome a greater resistance, introduced the charge of air into the cylinder at a higher pressure.

There was, however, no immediate recognition of the importance of Hamilton's invention. For example, in a paper on "Gas Power for Electric Lighting," read before the Institution of Civil Engineers on January 10th, 1893, J. Emerson Dowson remarked that "in the Otto cycle, each new charge of gas is diluted with a considerable portion of residual products, as well as with an excess of air. This is claimed as an advantage, as it is supposed to prevent all the gas from being fired at the beginning of the stroke, so that the pressure may be maintained and the shocks be less severe." Dowson did not, at that time, either support or controvert the alleged advantage of dilution with residual products, though he expressed the opinion that "the real merit of the Otto cycle lies not so much in the dilution of the gas with spent products of combustion, as in the engine being able to draw in, compress and fire the charge in one, the same, cylinder." Gasmotorenfabrik Deutz, proprietors of the German Otto patents, in a written contribution made to the discussion on the same paper, declared that "There was no difficulty, in spite of the presence of the products of combustion, in conveying to the cylinders a sufficiently strong charge of generator gas, provided that the passages of admission were large enough; exact ignition was easily obtained by graduating the compression accordingly." This declaration by Gasmotorenfabrik Deutz did not deter James Atkinson and Francis William Crossley from applying, on September 8th, 1893, for patent No. 16,900, "Improvements in Internal Combustion Engines." The patentees state that the object of this invention is to more or less completely clear burnt products from the compression space of four-stroke engines, and to replace them with pure air, "so that the total contents of the cylinder shut in for compression and subsequently ignited consist almost entirely of pure air mixed with the combustible gas or vapour which is used as fuel. The burnt products commonly found in engines of this type being replaced with air, more complete and perfect combustion is ensured, also if desired more gas can be satisfactorily burned." The provisional specification goes on to state that the object in view is accomplished "by sweeping through the compression space with pure air at about the time when the exhaust stroke is being completed and the suction stroke is commencing. We form the compression space, and so arrange the air suction valve and the exhaust, that a current of air passing in through the air valve sweeps through this space on its way towards the exhaust valve driving the burnt products in front of it; we have a suitable length of exhaust pipe between the engine and any exhaust box or the atmosphere, and in this exhaust pipe we set up a powerful current by means of the pressure left in the cylinder at the termination of a working stroke, more or less assisted by the rapid movement of the piston on the exhaust stroke, in such a manner that towards the end of the exhaust stroke there is a partial vacuum in the cylinder. Before the end of the exhaust stroke we open the air suction valve freely, also we do not close the exhaust valve for some very considerable portion of the earlier part of the suction stroke. During this period the induced scavenging current of pure air sweeps out the burnt products. The air suction pipe may also be of some considerable length with advantage, as in case the suction valve is opened too early the column of air in the suction pipe is not easily set in motion the wrong way."

It is further mentioned that in order to obtain the full advantage of this invention the suction and exhaust valves must both be open at the same time for a notable proportion of a revolution; say, while the crank pin is travelling through from 60 deg. to 90 deg. The provisional specification (which is signed by James Atkinson) concludes with the following paragraph: "It will be evident that an engine without any air suction pipe or a very short one, is capable of being scavenged by the action of the exhaust pipe only, when the valves are actuated as described above." The drawing accompanying the complete specification shows the streamlining of the combustion chamber, air passages, and exhaust passages. There is one claim, this covering, in addition to the timing of the valves, the "suitable" formation of the compression space, air passages and exhaust passages, as well as the use, in combination, of a long exhaust pipe. The specification is of much interest, since it describes what has become known as the Atkinson exhaust resonance system, utilising (in association with an overlap between the air opening and the exhaust closing) the inertia of the rapidly moving gases in the exhaust pipe. It is appropriate to remember that the arrangement of valve setting had already been suggested and used by Hamilton.

The improvement in performance ensuing from the better scavenge of the Crossley Otto engine was amply confirmed in tests made by Dugald Clerk and by James Atkinson, who found that the indicator thermal efficiency of the scavenged engines ranged from 25 per cent. to 28 per cent. while the I.M.E.P. could be very greatly increased. Atkinson stated that during brake tests on an engine of this type with cylinder 11½in. (292 mm.) diameter by 21in. (533 mm.) stroke, speed 174 r.p.m., he obtained a mean effective pressure of 98·75 lb. per square inch (6·95 kilos. per square centimetre). The Atkinson-Crossley induced scavenge had, however, its limitations. The vacuum obtained with the long exhaust pipe was not easily adjusted, and the improved performance was more or less confined to full-load conditions or to steady-load conditions at outputs not lower than half full load. With varying load, the behaviour of the gases in the exhaust pipe was capricious, and the system, to be really satisfactory, would have required a scavenging pump, *i.e.*, a reversion to Hamilton's positive scavenge. Nevertheless, commencing in 1895, Crossley Brothers built a number of engines embodying the features described in patent No. 16,900/1893, the engines being mostly in 25 H.P., 30 H.P., and 40 H.P. sizes.

Even then it was still a matter of some controversy whether the products of combustion should or should not be retained in the compression space of gas engines. Dugald Clerk, writing in 1896, mentioned that many of his experiments were conducted with a view to ascertaining whether or not the retention of the products of combustion in the compression space was advantageous, his own contention being that they were not. He remarks ("Recent Developments in Gas Engines," Inst. C.E., 1896) that, "From being among the most prominent holders of what may be called the 'combustion products' theory of the cause of economy in gas engines, Messrs. Crossley have entirely adopted the Author's view of the causes of economy in the modern gas engine; and their new invention offers proof that considerable advantages are to be obtained by clearing out the whole of the burned gases." Such is the inertia of the human mind that it was not until the general introduction of producer gas that the illusions as to the "combustion products" theory received their quietus. Speaking in the discussion of papers read before the Institution of Mechanical Engineers in 1908, J. Emerson Dowson

remarked as follows: "Speaking roundly, only 50 per cent. of producer gas was combustible, and of this the carbon monoxide was comparatively slow to ignite; the other 50 per cent. consisted of nitrogen and carbon dioxide, which were incombustible. If, therefore, the combustible gas were further diluted with residual products, the difficulty of ensuring complete combustion would necessarily be increased." It is worth while noting, however, that the gradual increase in compression pressure—a movement powerfully accelerated by Hamilton—automatically brought about a reduction in the quantity of residual products, since increase of compression pressure was arrived at by reduction of the clearance volume. Writing on this subject in 1937, F. W. Lanchester states that "The elimination of residuaries in the gas engine had three advantages: the quantity of charge is increased about 20 per cent. with a corresponding increase in horsepower; when cut-out governing is employed, the conditions when running under full load or at light load are the same; and last, but not least, with scavenging a higher compression may be employed without the same risk of detonation."

While controversy as to the "combustion products" theory persisted for much longer, the year 1898 may be said to have settled the matter from the point of view of practical engineering science. This recognition ensued from the outstanding success which Hamilton achieved in the construction and operation of large gas engine cylinders. The classic instance among these proofs resulted from the public-spirited action of Brunner, Mond and Co., Ltd., in placing orders for two horizontal gas engines of larger size than any previously built in Great Britain. One of these engines was designed by Hamilton and built at Sandiacre in 1898–99. The other engine was designed and built by Crossley Brothers. Both were installed by Brunner, Mond and Co., Ltd., at Winnington, where they were direct coupled to continuous-current generators and took gas from the same Mond gas producers. The engine designed by Hamilton was, at the time of its construction, the largest gas engine in Great Britain. It had two power cylinders arranged in tandem, there being a third cylinder for pumping the scavenging air. Each power cylinder had a diameter of 28¼in. (714·17 mm.). The diameter of the scavenging cylinder was 43½in. (1104·7 mm.). The stroke of all pistons was 30in. (762 mm.), the normal speed 125 r.p.m., and the full-load output 650 I.H.P. The scavenging piston not only pumped the scavenging air, but with its cylinder acted as a crosshead and guide. A feature of the engine worth mentioning was the design of the connecting-rod small end bearing. The piston pin was fitted in the eye of the connecting-rod, the journals being arranged trunnion fashion on each side. In this example the support for the connecting-rod small end was assembled on the front of the scavenge cylinder piston (diameter 43½in.), where there was plenty of room for large bearings. On test at Winnington (December 7th, 1900), working with Mond gas from cheap bituminous slack, the average I.M.E.P. was 107·4 lb. per square inch (7·55 kilos. per square centimetre) (front cylinder) and 109·1 lb. per square inch (7·66 kilos. per square centimetre) (back cylinder). The results of the tests showed the indicator thermal efficiency to be 37·76 per cent., calculated on the lower calorific value of the gas. This figure constituted, at the time, a record for gas engines, and is, indeed, rarely surpassed to-day.

The competing engine (designed and built by Crossley Brothers) was of the horizontal two-cylinder *vis-à-vis* type, each cylinder having a diameter of 26in. (660 mm.), stroke 36in. (915 mm.), speed 150 r.p.m., full-load output 400 I.H.P. Operating with comparatively low compression pressure (rather less than 80 lb. per square inch) and lacking the features—such as the positive scavenge and water-cooled pistons and exhaust valves—which, in Hamilton's engine, enabled higher compression and mean effective pressures to be reached without any counterbalancing disadvantages, the indicator thermal efficiency of the Crossley engine was ascertained to be 29·42 per cent., with brake thermal efficiency 24·43 per cent., both calculated on the lower calorific value of the gas.

The horizontal tandem engine designed by Hamilton for Winnington was among the earliest gas engines to be fitted with water-cooled pistons and water-cooled exhaust valves. Actually, water cooling of the piston had been used by Hamilton as early as 1896, and water cooling of the exhaust valves in 1895. It is illustrative of the lead taken by the British designer over Continental designers that Gebrüder Koerting, of Hanover, should, in their large horizontal four-cycle gas engines, have inserted a cast iron cooling box into the combustion chamber, the cooling box being water circulated and positioned between the inlet valve and the exhaust valve in the hottest part of the combustion chamber. The object of this barbarous makeshift was to enable the compression pressure in large cylinders to be put up to a comparatively high value without pre-ignition of the charge.

In the discussion on the paper "Power Gas and Large Gas Engines for Central Power Stations," read by Herbert A. Humphrey in 1901 before the Institution of Mechanical Engineers, some exception was taken to the use, by Hamilton, of water cooling on the pistons. The critic was Mr. (afterwards Sir) Dugald Clerk, who, with the juridical caution appropriate in a patent agent, expressed the belief that "with care a water-jacketed piston would succeed although there were very few at work yet." In point of fact, it was ascertained that in the Premier engine at Winnington, with compression pressure of approximately 120 lb. per square inch, maximum cylinder pressure about 330 lb. per square inch, indicator M.E.P. 107·05 lb. per square inch (7·522 kilos. per square centimetre) and I.H.P.=320·92, as much as 30,222 kilo-calories per hour (119,920 B.Th.U.) was carried away in the water delivered through the piston, only the back cylinder being at work. This engine was in more or less continuous service from 1900 until 1922, in which year—or shortly afterwards—it appears to have been dismantled and broken up.

A smaller but almost equally notable engine was the one designed by Hamilton for the engineering laboratory of the University of Birmingham. The tests made on this engine are detailed in the report made by Professor F. W. Burstall in 1908 to the Gas Engine Research Committee of the Institution of Mechanical Engineers. The engine was of the positive scavenger type with single cylinder 16in. (407 mm.) diameter by 24in. (610 mm.) stroke, speed 170 r.p.m. This unit was quite standard, except that arrangements were made with a view to operating with compression pressures up to 200 lb. per square inch and with charges estimated to give an initial pressure of 600 lb. per square inch. The admission and exhaust valves were horizontal, the combustion chamber wall of the breech end being flat. Lodge high-tension ignition was used, oil cooling of the ignition plug being employed for compression pressures above 160 lb. per square inch. Tests were actually made with compression pressures of up to 222 lb. per square inch (15·6 kilos. per square centimetre), an indicator thermal efficiency of 39·4 per cent. being reached with compression pressures of from 212 lb. to 222 lb. per square inch, and I.M.E.P. of from 80 lb. to 86 lb. per square inch (5·624 kilos. to 6·045 kilos. per square centimetre). The highest indicator thermal efficiency was obtained with compression pressures of from 168 lb. to 175 lb. per square inch, the average indicator thermal efficiency figure for four tests in this range of compression pressures being 41·5 per cent. with I.M.E.P. of from 87 lb. to 99 lb. per square inch (6·116 kilos. to 6·959 kilos. per square centimetre). Incidentally, it was concluded by Professor Burstall that the whole of the experiments pointed to the fact that "the most economical mean pressure is very considerably below the maximum which can be maintained, and that the highest economies are obtained with a comparatively low maximum temperature."

(To be continued)

The Engineer, the Architect, and the Surveyor in Town and Country Planning*

TWO or three years ago, in connection with the American defence housing programme, an agreement was reached between three professional bodies, the civil engineers, the architects, and the landscape architects of America, concerning the division of their respective duties, and something in the form of a specification was drawn up covering this matter and laying down specific items which would be dealt with by each of the three in any scheme involving the lay-out and construction of estates. It is not necessary to consider the details of these specifications; there is nothing particular about them which varies in any way from normal practice in this country; but certain general remarks were added, laying it down that the category into which the scheme would normally fall by reason of its main characteristics would usually determine the profession which would provide the individual to take charge of the whole. For the purposes of the present discussion, we might well substitute the surveyor for the landscape architect, because in this country a surveyor is usually understood to be a person who deals with the management and lay-out of estates, or, in the case of the quantity surveyor, with the business management of the contract.

In any consideration of the respective parts to be played by each of the three individuals mentioned in our terms of reference, it is necessary to get a clear appreciation of the fundamental aspects of the basic training of each of these persons, and to ignore the fact that there is a natural and proper over-

* Conference at The Institution of Civil Engineers, October 6th, in connection with "Practical Planning" Exhibition. Opening remarks by Mr. Manzoni, Chief Engineer of Birmingham.

lapping in any scheme which any of them might undertake.

The engineer is first and foremost a scientist, much of his work being based upon the pure science of mathematics; and, in consequence, his tendency is to be most assiduous in the collection of facts and to apply to them the most recent scientific knowledge in the solution of the problem at hand.

The architect is, or should be, an artist, and art is necessarily allied more to imagination than to logic. The function of the architect is the creation of beauty and its interpretation in the materials at his disposal to provide a structure which will be harmonious in an æsthetic sense. The estate surveyor, in addition to certain technical aspects of his training, is usually skilled in business management and has much to do with the economics of any plan with which he may be entrusted by his client. He has to take within the ambit of his control a range of considerations quite outside the scientific or the æsthetic.

It is obvious that these generalities are complementary. In almost any project of magnitude that will be so, and we find in history that the craftsman of bygone years usually combined all three considerations within his individual conception and control. The rapid advance in the scientific use of materials, the industrial expansion of the country, its growing population and the magnitude of the works carried out have necessarily led to specialisation, and to a somewhat unfortunate division of these functions. In these days it is quite impossible for any one person to take all knowledge for his province; more and more the specialisations multiply, and each develops a somewhat particular type of mind. It is probably impossible to-day for any individual man to be outstanding in the spheres of both engineering and architecture, and if we expect the further aspect of economic management to be added we still further intensify the problem.

Town and country planning, as it has developed, is a very comprehensive subject indeed. It is no longer a restrictive code, as it has been in past years, but rather it is being thought of as a positive programme for long-term construction, involving all the environmental necessities of a modern community, commencing with the industrial lay-out of the country, through the stages of regional and local detail, right down to the design of the factory, the dwelling, and the playground and their furnishing. It includes considerations of transport, of the utility services, and of all amenities. It is quite certain that a task of such magnitude requires the specialisations of all three professions, and of many more besides.

There are engineers who, by reason of their temperament and experience, are better artists than some architects, and also there are architects who, from similar considerations, are better scientists than some engineers. I have met both sorts; but, generally speaking, the best architects are not good scientists, and the exact converse applies to engineers. This means that in order to get the best of each aspect of a scheme it is necessary that both—or I should say all three, with the surveyor included—should co-operate in the details of any planning project.

It may be of interest briefly to explain the procedure which has been followed in the planning of the redevelopment scheme for the district of Duddeston, a map of which is shown in this Exhibition, because this is a project equivalent in size to a small town, and which has been carried through all the stages from preliminary consideration to ultimate design.

The idea originated during the early 'thirties and arose out of considerations which were purely sociological. The medical officer of health reported on the condition of certain blocks of properties to the estate manager, who is in fact a surveyor—a surveyor and valuer—and from general considerations it occurred to him that something wider than the normal application of procedure under the Housing Acts was called for. He made certain investigations concerning the proportion of dilapidated houses and considered a number of facts which were evident to him from his normal management of estates, such, for example, as local demand and industrial and residential balance.

He then got into touch with me, because in Birmingham I am responsible for a range of subjects under the general heading of physical planning and construction. It was obvious from a study of the map that here was an area which could easily be isolated, and that the first thing to do was to make a survey of existing conditions. This fell, naturally, within the sphere of the town planning department, which includes people used to the procedure of referencing and the collection of statistics and their analysis. When the necessary survey work was completed and the particulars of conditions above and below ground ascertained, an appreciation of the necessities of the area could be made, and this was carried out by the same department.

The next matter arising was traffic circulation, and here the engineers of the road department were brought in. At the same time, matters of zoning for industrial and residential use and the provision of open spaces were interwoven with the main road lay-out by the town planning officer. Then followed a request for detailed consideration by a number of persons on a variety of subjects—drainage, gas, water, electricity, schools, medical services, &c.—the special departments being asked to indicate their own requirements in accordance with the draft road and zoning lay-out sent to them.

From this point certain legal formalities had to be undertaken and financial considerations had to come in, so that the lawyers had to come in, and also rough estimates had to be prepared. In fact, the war intervened at this point, but when it was possible again to resume consideration of the matter the legal aspect had reached a stage where detailed lay-outs had to be prepared, and then the housing architect came into consultation and virtually took charge from that point, and within the framework already reached he considered what may be described as the three-dimensional aspects of the scheme. During this consideration all the former work was reviewed, in order that the whole could be fitted together, and also certain sociological researches were pursued into such matters as family analysis and the particular requirements of different income and family units, and including—and this is most important—the expressed wishes of the residents so far as they were ascertainable or already known.

The result, through the stages of a number of alterations, is the scheme as it appears to-day; but it still has to be taken further in the detailed design of buildings, of roads and services, and of landscape gardening, again involving all the people hitherto consulted, before work can actually be commenced.

It is fortunate that many of the specialist departments are grouped together in Birmingham under a single control, and are therefore subject to a unified direction. It is clear that the most controversial aspect in the past has been concerned with prestige; it centres round the claim of any particular profession to be entrusted with the principal *rôle* in the preparation of planning schemes. My own reaction to this controversy is that it makes not an atom of difference whether the chief executive is an engineer, an architect, a surveyor, or just a business man, provided he has sufficient knowledge of all these subjects and, above all, the right kind of training and temperament to give to each aspect its proper place in the general picture.

This does not mean that it is only necessary for such a man to realise the importance of engineering or of science or of architecture or of economics or of the other aspects concerned, but that he has had sufficient technical training and knows enough about the latest discoveries, theories, and tendencies to be able to give to each its proper place and weight. Such men, I am afraid, are not very abundant. I have said elsewhere that a man entrusted with planning should be a person whose whole life and circumstances are part of the plan. Preferably he should be a local man, a man who knows the conditions because he lives in them. But it is certain that whoever does guide such a team of planners ought to have very specialised local knowledge, sociological and economic, if he is going to make a real job of the whole conception and of the details. I am not sure that the most successful men are not those whose temperament and training are opposites, but I am quite certain that the choice of such individuals is very difficult, and should not rest upon a person's reputation in his own specialised sphere.

It may be that in years to come we shall, by a particular course of training in the universities, produce a new profession, but at the moment the best qualifications are usually held by men who have been thoroughly trained and have practised in one of these three professions, and who, in addition, have had opportunities for gaining a wide experience of the others, and also of the social and economic background of communities. The worst thing that could happen at the present time—unfortunately, it has been happening—is that members of the different professions should continue to cry aloud their own claims by derogating the claims of others, because this must inevitably shake the confidence of a public which is becoming more interested and more informed, not to mention more clamorous, concerning the post-war world.

Standardisation of Tramway Feeder Pillars.—A specification and drawings are now available, giving recommendations for the design and construction of feeder and section pillars on tramway and trolleybus systems. These have been prepared by the Joint Overhead Equipment Committee of the Municipal Passenger Transport Association, Incorporated, and the Public Transport Association, Incorporated, the two organisations which include in their membership all the tramway and trolleybus systems in Great Britain and Northern Ireland operated for public transport. No standards have existed in the past, and manufacturers have therefore been called upon to study a wide variety of types and arrangements to meet the preferences of individual operators and consulting engineers. Some time ago the Joint Committee accepted a suggestion that it would be desirable, without proceeding to rigid standardisation, to provide for some measure of uniformity in the main features of feeder and section pillars, so that manufacturers' tenders could be more uniform in essentials. In making their recommendations, the Joint Committee has had in mind the possibilities of post-war developments. Thus, the recommendations are applicable where tramways may be converted to trolleybus systems or new tramway or trolleybus route construction is required.

The Threshold of a New Era in Transport*

By Sir WILLIAM V. WOOD,
(*President L.M.S. Railway.*)

SOME prominence has been given to a statement by a member of the Government that it would be wise to bring transport under public ownership in order to ensure the maximum and most efficient service, adding the surprising remark that controversy on this should be limited because there is a considerable degree of agreement on it among politicians. I should have thought that before there was agreement amongst politicians there would have been reasoned consideration, in a practical way, of the merits or demerits of the existing transport facilities from the point of view of the public using them. Surely, the proper course is to consider the merits of what has been provided by private enterprise, to inquire whether it has fallen short of public needs and, if so, in what ways, and then whether the responsibility rests with its owners or with Parliament. When that is done, and only then, is it possible to consider what further action is required and the form it should take. I am no believer in standing still, but I am a firm believer in weighing up the facts before moving in a critical matter of this kind. The four main line railway companies are under the unique obligation to give an annual account of their stewardship to a court of law so that the court can report whether they have conducted their undertakings with efficiency and economy. Other forms of transport, alike with industry in general and trading concerns owned by the Government or local authorities, have not to pass that test, but, judging from what I know of the larger non-railway transport undertakings in Great Britain, the industry generally could do so, if required. There cannot, of course, be 100 per cent. efficiency in any progressive business, as almost any development carries with it the chances of success or failure; but if a "blue-print" were to be introduced in an endeavour to ensure success, it would kill initiative and with it the spirit which created the developments of this country in the last 100 years and raised immensely the general well-being of its people.

There are many things I would like to see done to improve the transport industry of this country, with its millions of customers daily and its huge variety of distinct services largely dependent on the initiative of the man on the spot, but I cannot see them being done, or even the present standards being maintained, under State ownership or State management, responsible as it must be to parliamentary control. Science has its place and an important one, but the day-by-day conduct of the various services of a comprehensive transport undertaking is an art which cannot work properly to rigid rules either in war or in peace. I know that it is suggested in some quarters that transport under State ownership would be a means to regulate the spread of capital outlay or to perform social services for nothing or at cheap rates. I have heard no suggestion that, say, the Post Office should give free postage or cheap postage to invalids or other specified people; but the railways have been called upon to undertake, and have undertaken, special works to relieve unemployment, to charge low rates for shipment coal and low fares averaging ½d. per mile for workmen. But subsidies to individuals through transport, which Parliament may wish to provide, do not necessitate State ownership or management of transport. There is, however, clearly a proper limit, and if, for example, all fares were workmen's fares, the business could not be self-supporting. It has been my lot to have to spend many hours in witness boxes and elsewhere explaining why transport cannot subsidise everyone who has a special case to plead. I should add that, as a principle, I do not believe in subsidies to transport, or industry generally, and, if they are granted, they should not be hidden.

I should not have referred to this question of ownership but for the spate of propaganda upon it in recent months, suggesting that there is general agreement that transport should be State owned or State managed or privately owned and managed by State nominees, although no one has made the suggestion, and supported it with facts, that transport has failed to function properly under private ownership and parliamentary regulation. Some of the statements arise from political convictions which, to me, are unsound; some are due to a hope for advantages at the cost of the taxpayer, and some, perhaps, to a wish to give a sop to Cerberus.

But I have said enough on these speculations on the future ownership of transport, and prefer to turn to the post-war problems of the transport industry on the assumption that, as an industry, it will continue to develop its services to the public and adapt them to the needs of the post-war world instead of being merged in the State, as in various other countries. It is sometimes conveniently forgotten that the vast bulk of public transport in the world is still provided by private enterprise, but it is significant that the United States as well as Great Britain relies on private enterprise.

In Great Britain I see three roughly distinct groups of post-war problems: (1) The relations of the parts of the transport industry to each other and of the whole to transport users and the State; (2) those arising from the natural genius of the people in the industry to find new and better ways of conducting it; and (3) those arising from the effect of the war on transport requirements at home, on the seas, and abroad.

On the first, I think recent experience points to an easing of the acute differences of, say, ten years ago, arising in the main from the competition between the young road motor transport industry and its older rivals with greatly differing obligations and traditions, due in part to parliamentary regulation and in part to custom—differences more important than those arising from the nature of the forms of transport and the incidence of track costs. I consider that the way is now clear for the adoption of complete equality in regard to charging powers, leaving the users of public transport free to choose the system they prefer to use at a particular time, thus achieving a natural allocation of traffic between the various forms of transport. It would permit a system of correlated charges, not necessarily uniform, agreed between the forms of transport.

* * *

Turning to the relations of the industry to its users and the State, I do not doubt the desirability of regulations laid down by Parliament and applied by a tribunal, concerning the reasonableness of facilities and charges, the permissible return on the capital employed, and the consequential accounting records. Has not the time arrived when all forms of public transport should accept the obligations attaching to public services, which shortly are publicity and measurement of their operations, and the access of their users to a simple tribunal in regard to the reasonableness of charges and facilities? On the last point I would like to see the creation of area joint bodies of users and the various providers of transport, which would discuss matters of common interest, including charges and facilities, and endeavour to settle them by agreement. I realise that these steps I have mentioned in very broad outline require much consideration, but they have one aim, the creation of healthy conditions for the industry and the best possible transport charges and facilities for the public. The criticism will, no doubt, be made that co-operative action on these lines means a monopoly and would cause undue profits and lack of enterprise. But profits should be subject to limits settled by Parliament, and there should be competition in service.

* * *

More than ever we need in the development of the transport machine of the country to engage in the organised, systematic, and carefully recorded research which is necessary to maintain and improve its efficiency. I am not referring only to scientific research in physical and chemical laboratories, but also to the cost analyses and the comparisons of results in offices which "back-check" the merits of the new compared with the old or the same process at point A and point B, not in mere totals, but in detail, so as to find and then use the facts.

There is also the form of research which should precede what is now called planning; the regular inquiry in advance into the new transport needs of industry and population, and where and when movements of passengers and freight are likely to be required—all fundamental matters if the various transport needs of the new factories and population are to be dealt with adequately.

* * *

The third problem of the near future I would like to mention is the post-war change in the services the industry will require to perform. The mere advances in the technique of productive methods which the war has created, quite apart from their effects on the tools of transport, are bound to cause many changes in the conditions and location of industry. Developments of plastics; the many things wrapped up in the word "radiolocation"; new constructional methods in engineering processes and in building; rubber substitutes and rubber reclamation; pipe lines; synthetic petrol, and even the discoveries in coal conservation and substituted metals and woods caused by short supplies—all these are obvious illustrations.

War needs have also quickened greatly the developments of recent years in preserving foodstuffs, and in reducing their bulk by desiccation or dehydration to save transport space on ocean steamers. These greatly advanced ways of century-old practices will, no doubt, very largely remain with their effects on transport and its halfway stage of warehousing.

* Institute of Transport. Excerpts from the Inaugural Address delivered in London, October 12th, 1943.

Plywood Problems.—The increasing utilisation of plywood has led an American company to market a stopnut which has been tested and approved by the U.S. Army Air Forces. This stopnut can be installed from one side of the work; it leaves the outside of the plywood surface smooth, provides a washer surface, does not twist in the hole, is replaceable in the event of damage, and is independent of the thickness of the wood. The nut can be installed in three easy ways—driven in with a hammer, forced in with a press, or drawn in with a bolt.

The Engineer

OCTOBER 15, 1943

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Contents

THE ENGINEER, October 15th, 1943 PAGE

A SEVEN-DAY JOURNAL ... 297

LEADING ARTICLES—
BATTLESHIPS OF THE FUTURE ... 306
HUSH-HUSH ... 307

SPECIAL ARTICLES—
ENGINEER, ARCHITECT, AND SURVEYOR ... 303
ENGINEERS AND THE BRITISH EMPIRE. No. XV. (Illus.) ... 299
JOHN HENRY HAMILTON AND THE POSITIVE SCAVENGING ENGINE. No. II. (Illus.) ... 301
TELECOMMUNICATION ... 310
THRESHOLD OF A NEW ERA IN TRANSPORT ... 305

CONSERVATION OF WOOD. (Illus.) ... 312
FUTURE OF THE CHEMICAL INDUSTRY ... 312
FUTURE OF THE COAL INDUSTRY ... 314
P.V.C. CABLES ... 309
REVISION OF THE TONNAGE LAWS ... 309
SEA AND AIR TRANSPORT ... 300
17-POUNDER ANTI-TANK GUN. (Illus.) ... 314

LETTERS TO THE EDITOR—
WHAT IS "WORK"? ... 308
PRACTICAL PLANNING ... 308
THE pH VALUE OF BOILER FEED WATER ... 308
RELATIONS OF ARCHITECTS AND ENGINEERS ... 309
HORSEPOWER OF AIRCRAFT GUNS ... 309

OBITUARY—
SIR. J. FORTESCUE FLANNERY ... 307

NEWS AND NOTES—
AMERICAN ENGINEERING NEWS ... 314
FORTHCOMING ENGAGEMENTS ... 316
MARKETS, NOTES AND NEWS ... 315
NOTES AND MEMORANDA ... 316
SIXTY YEARS AGO ... 309

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BATTLESHIPS OF THE FUTURE

THE first duty of those who wish to design and build the battleships of the future is to look ahead. They cannot afford to be trammelled by tradition. Nor can they afford to misread the lesson of a major war. No sane man would divorce himself from the hope that there will never again be a major maritime war—or at least that war may be averted beyond the span of life of any ship which may now be designed or built. Nevertheless, warships, and particularly heavy warships, cannot be improvised at short notice to meet the needs of the moment. Policies may change rapidly, and while these are likely to have a bearing upon naval requirements, they should have no influence upon immutable truths which are naval and constructional rather than political or diplomatic. It is for this reason that tremendous responsibility rests with the planners, designers, and constructors. They must not cease to study the realities, as opposed to the conveniences, and thus be ready to come forward duly prepared when, as has so often happened in the past, convenience calls in reality to the rescue of the politicians, the diplomats, and the nation itself.

It is with a due sense of this responsibility that every suggestion and trend should be examined by those who may design and build our future bulwarks of Empire. Two naval architects of some standing in the United States recently presented a paper to the Society of Naval Architects and Marine Engineers in New York. They were Mr. Walmer E. Strope, of the United States Navy Department in Washington, and Mr. Stanley J. Dwyer, of the Federal Shipbuilding and Drydock Company. Before turning to the subject of the paper presented by these two authorities, one is struck by the fact that here is a naval expert collaborating with a shipbuilding expert. This is a type of partnership all too rare on this side of the Atlantic. We are far too prone to think that warship design is the exclusive prerogative of the purely naval designer and constructor, although it is obvious that these must be unduly influenced by the political and staff appreciations of requirements and will inevitably try to bend the practical designers and builders to their will. The thesis of Mr. Strope and Mr. Dwyer is no less interesting and no less worthy of study. It was that there should be a reinvestigation into the practicability of the small-displacement capital ship for the United States Navy. In common parlance this amounts to recommendation of the adoption of the "pocket battleship" in place of the mammoths of to-day. That such a recommendation should emanate from the United States, for so long the leader in size of capital ships, is sufficiently remarkable; but this in itself argues that the theories which they produce have been most carefully thought out and weighed against all available evidence. The ship visualised in this paper was one of between 10,000 and 20,000 tons displacement, with a main armament of either six 14in. guns or four 16in. guns. It was argued that economy of weight and space dictated the use of as few turrets as possible, and that two turrets, one forward and one abaft the superstructure, would provide a balanced design which would satisfy gunnery requirements. It was further stated that "the small capital ship can, on a ton-for-ton basis, incorporate a greater volume of fire from the main battery than the large displacement capital ship." Nobody will find fault with either of these statements, but there are many who will fail to see in them any forceful argument in favour of the "pocket" capital ship.

The champions of the small capital ship state that armour plating can be as thick on the small ship as on the large ship, and that the small ship can be built quicker on ways not capable of accommodating vessels of modern capital ship tonnage. Docking and repair facilities would also be simplified. These statements are incontestable; but, unfortunately, one cannot make a habit of getting a quart into a pint pot. Something has to be sacrificed. The number of guns has already been reduced, but this is not enough, and the enthusiasts of the small capital ship aver that the one quality which can be reduced without impairing the fighting efficiency of the ship is speed. Here there is room for almost unlimited controversy, but it is necessary to view the matter in the cold light of realism and such lessons as have been learnt in modern war at sea. In their production of "pocket battleships" the Germans sacrificed not only speed, but armour protection, and, to some extent, gun power. There has been but one action with these ships—the Battle of the River Plate, where the "Admiral Graf Spee" was worsted and driven into the shelter of a neutral port by cruisers of greatly inferior gun power and protection, but with an advantage in speed. There is no doubt that this inferiority in speed gravely hampered the German and was, in fact, the reason why she was brought to action. There is another point. It was a prolonged action, towards the end of which shortage of ammunition for the 6in. guns of the cruisers was beginning to be felt. It seems probable that shortage of ammunition for the German 11in. guns played its part in dictating a course of action to the German captain. There are strict limits to the number of rounds for big guns that can be carried in a small ship. Thus, while there is no disputing that the small ship can "on a ton-for-ton basis" incorporate a greater main armament volume of fire than a large ship, other factors have to be sacrificed which may prove decisive in war. The prolonged chase of the German battleship "Bismarck" teaches the opposite aspect of the same lesson. The "Bismarck" was a great ship—opinions varied, but their consensus placed her tonnage in the neighbourhood of 45,000. She proved herself to possess certain outstanding qualities under prolonged action conditions. She had immense hitting power, and at the same time could herself stand up to terrific punishment without her fighting efficiency being seriously impaired. She could steam great distances at high speed without apparent regard to expenditure of fuel, although it was stated that she had left Norway without all her tanks full, and one of her fuel tanks was certainly pierced in action, with consequent loss of fuel. It was the incorporation of these qualities which had dictated the displacement of the ship. The German designers had worked to specifications for performance rather than within rigid limits set by treaty, economy, or convenience. Compromise had, in fact, been reduced to a minimum.

It is devoutly to be hoped that the post-war world will find some sane method of checking the ever-growing size of capital ships, but it is of paramount importance that the lessons of this war should not be submerged in idealism. So far as capital ship construction is concerned, these lessons may be summed up as follows:—The ships must be designed and built for the tasks which they will be expected to perform, rather than in accordance with idealistic theories. One must remember also that the capital ship is the ultimate arbiter of sea power, and, as such, it must be as strong or stronger than anything the enemy may be able to bring against it. Those who plan aggressive wars of attrition against our sea power can afford

to experiment in the hope of finding something which can strike effectively at our vital sea communications. They have little to lose by failure. A nation which lives by her sea communications and which will never embark upon an aggressive war must think otherwise. A mistake in designing the instruments of her sea power would throw away the freedom of the world.

Hush-Hush

The relatively early release of information, scanty as it is, about the new British 17-pounder anti-tank gun may be a welcome indication that the authorities and Ministries concerned do at long last propose to let the public know a little of the great achievements of British inventors, technicians, and scientists before they have become, by the efflux of time, merely historical. Hitherto, any effort of the Press to publish facts about technical attainments, even though they be familiar to the enemy, has been frowned upon. In consequence, the reputation of this country has been allowed to decline, whilst that of its Allies and of the enemy has been often unduly exalted. Not for a moment do we wish to suggest that valuable secrets should be divulged as long as they are hidden from our enemies as well as ourselves. But when it is known that equipment has fallen into enemy hands, when there can be no question that their engineers and scientists have had every opportunity of examining it in detail, no good reason why the public should not be fully informed with regard to it can be advanced. Very admirable and detailed descriptions of all the principal types of German aeroplanes, based on the examination of captured specimens, have been prepared and circulated by the Ministry of Aircraft Production. Excerpts from several of them have been reprinted in these pages. The Germans have made similar investigations of British aeroplanes and have circulated them widely, so that in some cases the best descriptions of British machines are only to be found in German publications. Aeroplanes are no more than an example which might be multiplied many times. Even at this day no clear description of radio-location as applied to the detection of aircraft has been made public, even though there can be little about it which is not familiar to German scientists and technicians. We dare not mention even the names of certain other things lest we should find ourselves in trouble. They are officially taboo in the country of their origin, though well enough known to its enemies.

The gravest disadvantage of this secrecy is that it all too often leads those of little faith to believe that the United Kingdom has shown neither the inventive skill nor the scientific acumen of other nations. Nothing could be further from the truth. If the facts could be revealed, it would be seen that this land is leading, not following. Its record of war inventions is unsurpassed, and even American visitors have admitted that its technical achievements in the field of production cannot be excelled. All the time new things and fresh developments are being made here. The revelation of the existence of "midget" submarines in His Majesty's Navy is a case in point. There, secrecy was essential because the element of surprise would favour the attack. That some things must be hush-hush for a time is not contested, but it is urged that particulars about them should be released at the earliest possible moment—that is to say, immediately they are known to our enemies—and not deferred to an indefinite future. In that way the pessimism of those of little faith would be routed, and the confidence of the faithful in the abilities of our own people would be fortified.

Obituary

SIR J. FORTESCUE FLANNERY

In our last issue we briefly announced the death of Sir J. Fortescue Flannery, Bart., which took place at his country home, Wethersfield Manor, Essex, on Tuesday, October 5th, in his ninety-second year. He was for many years well known as a marine engineer and naval architect of outstanding ability, and was the founder and chairman of Flannery, Baggallay and Johnson, Ltd., and the chairman of Callender's Cable and Construction Company, Ltd. For several years he was chairman of W. and T. Avery, Ltd., a position from which he only resigned at the beginning of the war.

Sir J. Fortescue Flannery

James Fortescue Flannery was the son of the late Captain John Flannery, of Seacombe, and was born and educated on Merseyside. In his early years he was priviliged to make several voyages across the Atlantic in the sailing ships commanded by his father, and thus gained a working knowledge of ships and the sea. He started his career in the office of Mr. David Campbell, a consulting engineer in Liverpool, and after a few months began to serve a five years' apprenticeship in the Britannia Engine Works of James Taylor and Co. at Birkenhead. Following his apprenticeship, young Flannery worked in the drawing-office at Britannia Works, and later was draughtsman with the then Liverpool firm of Fawcett, Preston and Co., Ltd. During his apprenticeship he attended evening classes at the Liverpool School of Science, an institution which at a later date was merged into Liverpool University. He was a very successful student and was first in his year, thereby gaining the Derby Prize. That year the prizes were presented by Sir Edward Reed, who only a few years before had retired from the office of Director of Naval Construction at the Admiralty. Sir Edward was struck by the ability of Flannery and offered him a post in his London office. During the next five years he gained a wide knowledge of the design of machinery and its inspection in service, and also gained some further seagoing service, as at that time Sir Edward was engaged in the design of warships for foreign navies. At the end of that period Flannery started in business on his own account as a consulting engineer and naval architect. He was able to get into touch with many shipowners and rapidly built up his reputation as a consultant in connection with the design and construction of cargo-carrying steamships. He was also appointed consulting engineer to the Wallasey Ferries Company. He played an important part in the development of the oil tanker in his capacity as consultant and superintendent of the tankers owned by the Shell Transport Company, which, we may recall, was founded by the late Lord Bearsted. Some of these ships were designed to carry oil in bulk and general cargo on the return voyage. Improvements made in connection with this idea resulted in the transportation of valuable cargoes without damage in the same tanks which had previously been used to ship petrol. Attention was also given about this time to the burning of oil fuel under marine boilers, which was initiated by Lord Bearsted and worked out by Flannery. The results were successful, and the Admiralty, being interested, sent some of its engineer officers to travel in the ships and to make observations. Knowledge thus gained proved useful to the further development of oil firing in naval ships.

With his increasing practice the firm of Flannery, Baggallay and Johnson, Ltd., was founded, and offices were opened in Liverpool in partnership with Mr. E. C. Given, as Flannery and Given, Ltd., and in Rotterdam with Mr. H. B. Gregson, Wh.Sc., as Flannery and Gregson, Ltd. Upon the death of Sir Edward Reed in 1906 Flannery, Baggallay and Johnson, Ltd., were invited to succeed him as consulting engineers and naval architects to the Crown Agents for the Colonies. In connection with this work Sir Flannery was responsible for the design and construction of a large number of ships for service in tropical climates and for use in the Dominions. His services to the nation were recognised in 1899, when the honour of knighthood was conferred upon him by Queen Victoria, while in 1904 he was made a baronet by King Edward.

In 1895 Sir Fortescue decided to stand for Parliament and was returned as Member for Shipley, Yorkshire, which he represented until 1906. After four years' interval, during which he unsuccessfully contested Cardiff, he returned to the House as Member for Maldon, Essex, the constituency in which he resided. He resigned his seat in 1922, owing to pressure of business. In Parliament Sir Fortescue was prominent in advocating the construction and maintenance of a strong Navy, and he was one of a small group of Members which before the last war defeated the attempt to reduce naval construction on the ground of economy.

In addition to his arbitration and consulting work, Sir Fortescue found time to take up other appointments in industry, and he was chairman of Callender's Cable and Construction Company, Ltd., and W. and T. Avery, Ltd., and a director of Barclays Bank, Ltd. He was an Associate of Lloyd's and served on the boards of some other companies. Among the institutions and scientific societies which he served as President were the Institute of Marine Engineers, the Liverpool Guild of Marine Engineers and Naval Architects, and the Junior Institution of Engineers. He was a member of the Institution of Civil

Engineers, the Institution of Mechanical Engineers, of which he was elected an Honorary Member in 1937, and the Institution of Naval Architects. He took an active part in the discussion of papers read at the spring meetings of the Institution of Naval Architects, when they dealt with the varied aspects of marine engineering, and particularly with the practice of combustion. One of his papers was on "Some Recent Experiments in Artificial Combustion," and another on "The Ventilation of Steamships, with Special Reference to the Removal of Explosive and Foul Gases from Bulk Oil Steamers." Sir Fortescue was a valued member of the Technical Committee of Lloyd's Register of Shipping and sat on that Committee for several years as the representative of the Society of Consulting Marine Engineers and Ship Surveyors, of which he was a founder member and President on two separate occasions. He was one of H.M. Lieutenants for the City of London and served as Magistrate for Surrey, Kent, Essex, and London. During his long and useful life he made many friends, and his work for the British shipbuilding and marine engineering industries will long be remembered.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

WHAT IS "WORK"?

SIR,—It is good to note that THE ENGINEER is providing space at this time for discussing the human problems of our particular activities.

On the question of "What is 'Work'?" the opposite, according to current interpretation, is pleasure. But work of a specific nature is pleasure to a certain mentality, and pleasure of a specific nature is boredom to the same mentality. If we take the engineer's definition of work, the foot-pounds exerted may be the same in each case. Does it not follow that, fundamentally, we have to modify our mental outlook? We of the older generation have been brought up within the four walls of engineering in its older sense. But the world is changing and knowledge is advancing at an amazing rate, and the tragedies of war are causing us to look still more deeply into the short life which is given to us in this world.

We are considering a big and important problem, which will doubtless take more than one generation to evolve. Some of your correspondents have gone into details, and Mr. G. Wüthrich has raised interesting thoughts under the title of "This Freedom," but we shall progress and fill in the detail if we try to visualise an ultimate goal, which now seems to be looming up into the daylight, and endeavour to fit our work (pleasure) into this grand scheme.

JOHN D. TROUP.

Purley, October 11th.

PRACTICAL PLANNING

SIR,—When you say, in your most interesting leading article under above heading in to-day's issue of your journal, that "all engineers are aware of the fact that our civilisation has been built upon and is dependent upon their own practical work," I presume you have only leading members and serious students of this most ramose profession in mind, for I am afraid the rank and file, whilst knowing it, are not fully alive to the fact that they are both the creators and potential destroyers of our civilisation. Neither do they, and much less the layman, realise that the engineer never sleeps; he is literally everywhere, at all times! Without in the least belittling the architect, he would be reduced to incompetence without the engineer. Not one of us can carry out the simplest task without calling upon the engineer. Herein, I submit, is an issue of fundamental, if not dire, portent. If the engineer does not keep himself up to date about the items on the credit side of the ledger of human existence, he is unlikely to bother with the debit side. If, as the creator of our civilisation, he refuses to accept any responsibility of a creator, the outlook is dark indeed.

It is not a bit of good blaming the poor politician for the poor flavour of the soup we are in, or the still more flavourless concoction we have a good chance of stepping into: the politician is the cook patterned and produced by the engineer himself. What would the bellows and vapourings of a Hitler or a Mussolini amount to without the loving attentions of their progenitor and mentor, the engineer. Why should it be so? Why, engineers, I ask, should you produce something great and wonderful only to allow a useless by-product to swamp and obliterate it? Why allow incompetent meddlers to mess about with the marvellous machine you have built up? Why do you not attend to the running of it yourselves? If you must have poor cooks and stokers and greasers, for mercy's sake keep an eye on them and see to it that they do not poison you, and let the boilers blow up and the bearings run hot.

Practical planning is the burning question of the day. Here British engineers have a unique opportunity. In the political field foolish short-sighted politicians are squabbling about control or no control. The engineer does not think in terms of control; he knows that in order to achieve anything, senseless scrambling only creates chaos. He knows that in the right sort of organisation, which is essential to all human progress, it is not a question of control or want of it, but wise direction and willing co-operation. He knows, better than any self-seeking politician, that in a world run on competitive lines, with its one acre per person, Britain's life blood is foreign trade, and we can only hold our own by the most strenuous effort on the part of efficiently organised big business, directed by our ablest captains of industry and the fullest co-operation by Government and people, shorn of every vestige of red tape.

Socialism for Britain is only possible in a fully socialised world. The mere idea of breathing control in connection with such men of genius and driving force, such masters of organisation as Lords Nuffield and MacGowan, Sir Felix Pole, Sir Malcolm Stewart, Mr. Arthur J. Rank, to mention just a few great captains, is more than absurd.

As for practical planning of new cities and homes, what marvels could British engineers not accomplish if they would only take their rightful place in the lead!

Just as an example of what British engineers could do if they cared to, I dare make a suggestion. Let British engineers within their own profession subscribe the capital to build a city for 50,000 people to astonish and earn the admiration of the whole world. There is some controversy as to the respective merits of flats and garden cities. British engineers could settle the controversy by building a city of beauty, peace, prosperity, safety, and health on a 1000-acre site, with 10,000 modern homes, each with a garage and garden adjoining, with 200 million cubic feet indoor extra space for churches, schools, cinemas, theatres, halls, workshops, sports and recreation premises, shopping arcades, &c., and 800 acres spare open space for parks, playing fields, lidos, allotments, &c. The city could be entirely self-supporting and an assured return on capital of 5 per cent. Rent and rates for working-class dwellings would average 15s. per week and in no case exceed £1. The city would be smokeless and facilities for several new industries would be provided. Buildings in all would only occupy 200 acres, which sounds absurd, but if we think of double-terraced blocks, each 300ft. long and five double storeys high, where the flat roof of a lower terrace forms the gardens for the next higher, with an extra common roof garden on top of all, it is quite practical. All schools would be on a high level and there would be overhead paths between blocks, so that no children need ever go amongst street traffic. Shopping premises could also be on a higher level. Direct access could be had to parks and playing fields without crossing traffic. One circular main road, one-way traffic, and through blocks instead of between.

J. H. FERGUSON.

Wellingborough, October 8th.

THE pH VALUE OF BOILER FEED WATER

SIR,—The article by Messrs Rees and Jackson on the measurement of pH values of boiler feed water in your issue of September 24th is an excellent contribution to the art of boiler feed water quality control, for it enumerates certain difficulties associated with boiler feed water conditioning now obtaining. This letter is not concerned with the measurement of pH, the article upon which, as might be expected from its authors, is an important contribution upon the subject, but with certain observations appearing therein.

It is stated that "electrical conductivity serves as a measure of the concentration of the ionic impurities which may be introduced in the feed water by condenser leakage or by carry-over from the boilers or evaporators, or by ammonia which is released in the evaporators and boilers and re-dissolved in the condensate." This is probably the first time the statement has appeared in print that evaporators do carry over and that they do not completely remove such gases as ammonia, facts which are usually contested by the plant suppliers when consideration to the design of boiler feed water conditioning plant is being given.

The article refers to the introduction of "ammonia which finds its way into the condensate at many power stations as a result of the heavy wartime chlorination of mains, which inhibits the action of nitrifying bacteria and so permits ammonia that would normally be oxidised before it reached the power station to enter the evaporators when it is distilled into the feed system. A concentration of ammonia equivalent to 0·1 p.p.m. NH_3, which is readily obtainable in this way, raises the pH value of the condensate to about 8·4 and the electrical conductivity by about 1·0 micro-mho per centimetre cube in the absence of carbon dioxide."

It would appear that normal evaporation does not remove the ammonia which results from the chlorine of public water supplies or is present in impure supplies, such as rivers, canals, &c. Chlorination is not only a wartime measure; it is a permanent feature of water engineering. While the wartime concentration may be higher than normal, when we return to peace chlorination will continue, but probably at a reduced residual. It does not follow that evaporators will be capable of dealing with the reduced dosage. Post-war stations will no doubt tend towards appreciably higher pressures and temperatures and even smaller concen-

trations than 0·1 part per 1,000,000 may become a potential source of danger if evaporating plants do not remove it.

The conclusion may therefore be drawn that modern conditioning of boiler feed must remove ammonia as well as scale-forming impurities.

S. B. Jackson.

London, S.W.1, October 5th.

THE RELATIONS OF ARCHITECTS AND ENGINEERS

Sir,—Mr. W. S. Morrison, M.P., addressing recently a joint meeting of architects and engineers, said that it was very desirable that these two bodies should work together in the common purpose of town planning and appealed to them to do so. If this course is adopted it would almost surely be a step in the direction of the delimitation of their respective spheres of activity. But what is wanted is not merely some accommodation for an *ad hoc* purpose, but a permanent allocation of their respective duties in the whole field of collective activity.

This point, you will remember, I dealt with in the paper on "Federation of the Professions," which appeared in your issue of July 30th.

In his work on "Unemployment in the Learned Professions," Dr. Kotschnig, formerly General Secretary of International Student Service, Geneva, published in 1937, says: "In Italy, where the system of professional registers is in force for most of the professions, the Fascist Confederation of Professional Workers recommends further that the limits and scope of each profession should be clearly defined. This has now been done in one case by the Act concerning engineers and architects, which defines in great detail the exact powers and field of activity of the two professions in question." For this information he was indebted to the International Labour Office, in its review of "Unemployment Among Professional Workers"—an office which, under the ægis of the League of Nations, has functioned admirably.

A. W. Crampton.

London, N.W.6, October 10th.

THE HORSEPOWER OF AIRCRAFT GUNS

Sir,—In his letter in your issue of September 10th, Mr. Helmer considers the mass of the gun and the projectile. Should he not also consider the aircraft itself as coming into the problem and treat it along with the gun? Suppose that the aeroplane is travelling at 300 m.p.h. and that after a burst of firing its speed is reduced to 100 m.p.h., must we not say that the reaction of the gun has had the effect of giving the aeroplane a negative velocity of 100 m.p.h. and work out the horsepower of the gun on this basis?

I have no information as to the precise loss of speed arising from the reaction of the gun or guns during a burst of firing, but I understand that it is considerable, and we must work out the horsepower of the gun accordingly, allowing for the fact that the recoil is working against the force given by the propellers.

C. Turnbull.

Tynemouth, October 5th.

P.V.C. Cables

Tentative amendments to the Rules for Electrical Equipment have been issued by Lloyd's Register of Shipping to cover cables insulated with polyvinyl chloride (P.V.C.). This material is now available as a substitute for rubber as cable insulant and sheathing and is approved, provided it is made and installed in accordance with these tentative rules. As this material has only recently become available on a commercial scale, the following notes, prepared by Lloyd's Register, may assist in correct application and the avoidance of unsuitable situations.

Polyvinyl chloride is a thermoplastic; that is to say, repeated softening by heat has no permanent effect and it will resume its original physical condition at normal temperatures unless excessive heat has caused permanent chemical change. Three qualities are available at present, one being used for sheathing purposes only, the second for insulating purposes, and the third for special applications. The first has inferior electrical properties and will not crack at −30 deg. Cent., whereas the second has good electrical qualities and will not crack at −25 deg. Cent. In general the advantages of P.V.C. for cable insulation and sheathing are:—(*a*) Improved fire-resisting qualities (it will burn when a flame is applied, but is self-extinguishing when the external flame is removed); (*b*) resistance to oil, petrol, benzine, and paraffin; (*c*) resistance to chemical attack (salt solutions, inorganic acids, alkalies, &c.); (*d*) low water absorption; (*e*) resistance to insect attack; (*f*) it is non-oxidising and does not perish with age.

The chief drawback is the softening effect of heat, coupled with a fall in tensile strength and electrical properties. It is soluble in solvents containing chloride and is attacked to a certain extent by ethyl acetate, acetone, and carbon-disulphide. Generally speaking, the main precaution to observe is to avoid situations subject to excessive heat. Softening begins to have effect at about 55 deg. Cent. (131 deg. Fah.), the material becoming increasingly softer as the temperature increases and if subject to pressure when at temperatures above this limit permanent deformation will occur. Where the source of pressure is such that relative movement does not take place no harm will result, but where the loading is due to gravity or is such that pressure in association with high temperatures is maintained until eventually the dielectric is reduced in thickness or completely penetrated, failure will occur. In this connection the temperature rise of the conductor, viz., 11 deg. Cent., when fully loaded must be taken into account so that in general precautions must be observed wherever the ambient temperature exceeds about 45 deg. Cent. (113 deg. Fah.), or where heat may be conducted from a connection stud or terminal.

In apparatus designed for currents below 100 amperes mechanical considerations usually decide the size of contacts and terminals, but it must be borne in mind that the British Standard Specifications permit total temperatures of 55 deg. Cent. for the terminals of switches, fuses, and circuit breakers and 70 deg. Cent. for bus-bars. Provided there is no danger of the insulant becoming squeezed out so that earths or short circuits occur, these temperatures may not be detrimental. There is a tendency for contraction of the insulant to take place, *i.e.*, the insulant may shrink away from the cable end. In general, apart from specially hot situations, which must be avoided, the following are positions to be carefully watched if they are associated with local temperatures above 45 deg. Cent. (113 deg. Fah.):—(*a*) Pressure under cleats and clips and in water-tight glands; (*b*) flexible cords for suspended fittings; (*c*) connection to studs or terminals which may exceed 45 deg. Cent. when fully loaded. In general, P.V.C. will be found superior to rubber provided due care is taken to avoid subjecting it to high temperatures, coupled with pressure or tension on the insulant.

Sixty Years Ago

Professional Etiquette

In a leading article in our issue of October 19th, 1883, we discussed the vexed question of professional etiquette among engineers and the possibility of action being taken against those who departed from it. The occasion for our remarks seems to have been provided by the action of certain unnamed municipalities which had been guilty of engaging leading civil engineers to draw up plans for local undertakings and then, after parliamentary sanction had been obtained for the schemes, throwing over their expert advisers and of placing the execution of the works in the hands of some local engineer. Such a course of behaviour, we said, was very likely to recoil seriously upon the offending municipalities, but our chief concern was with the interloping engineer, who was willing to allow himself to be made use of in the manner described. We had much to say in praise of the high dignity and honour of the civil engineer's profession and of the gentlemanly character of the great majority of those who practised it. Equally we expressed ourselves in biting terms concerning many corporations, the members of which frequently brought into their conduct of municipal affairs those principles which were currently accepted as standard among the class of people of which corporations were mainly composed. We recognised that, unlike the legal and medical professions, engineering had no supreme body capable of intervening effectively in cases involving breaches of etiquette, but we urged the Institution of Civil Engineers to take action among its own members, as it had the power to do. On at least one occasion in the past it had taken such action in a case involving one of its own Members of Council. We thought it desirable that all members of the Institution should be reminded of the fact that breaches of etiquette on their part could be brought to the notice of the Institution and that if after inquiry they were found to be at fault, they could be deprived of their membership.

Revision of the Tonnage Laws

In his Presidential Address to the Institution of Engineers and Shipbuilders in Scotland, delivered on October 12th, Mr. A. Murray Stephen made a plea for the revision of the tonnage laws. We reprint his concluding remarks.

When I come to review the whole position, I think that I am entitled to say that the present tonnage laws are a disgrace to the shipping community of the world and an insult to their intelligence. Their net result is:—(1) To waste the life work of a large number of skilled surveyors and much time in shipyard drawing-offices, where men have to learn the refinements of the tonnage laws and to become experts in the art of circumventing them by legitimate expedients; (2) to produce several forms of tonnage figures confusing to the layman and even to those in the industry; (3) to encourage owners to make openings in some types of ship, thereby making them less seaworthy; (4) to force designers to make machinery spaces much larger than they should be, leaving large empty spaces in the middle of the ship and discouraging new types of machinery; (5) to give considerable latitude to their interpretation, allowing the lax to score over the strict; (6) to make the tonnage of a loaded ship almost impossible to check; and, finally (7) to give anything but a fair assessment between ship and ship.

These seven evils, inherent in the present law, make it imperative that a clean sweep should be made, and a completely new and simple law evolved. No tinkering with the old law can be satisfactory. Any new, simple, well-thought-out, and fair law would be of enormous advantage to the shipowners, the shipbuilders, and the engineers. And now is the time for it. The root of the whole trouble has been the principle on which the old tonnage laws were based; that is to say, the earning capacity of the ship. If the alternative principle, which is obviously the right and equitable principle to use, namely, the cost of the service rendered to the ship, had been employed, the tonnage laws would not have got into anything like the muddle in which they are to-day. Even if they were to be revised now, if they were to continue to be based on the wrong principle, they would almost certainly get into a muddle again. I cannot too strongly emphasise that, in my view, it is this fundamental mistake of principle which has caused all the trouble and which will continue to cause trouble until it is altered.

Telecommunication*

By Colonel Sir A. STANLEY ANGWIN

International Control and Standardisation

PERHAPS more than in any other branch of engineering it is essential in telecommunications to have some measure of international regulation and standardisation, and this will be accentuated in the future with the very great expansion in communications that may be expected throughout the world.

The necessity for such regulations was realised at an early stage. The first International Telegraph Convention was that of Paris (1865), and the first International Radiotelegraph Convention that of Berlin (1906). These and subsequent Telephone and Radiotelegraph Conventions were abrogated and replaced by the International Telecommunications Convention of Madrid (1932) and the Regulations annexed thereto, the latter subsequently modified by the Cairo Regulations (1938). These Conventions and Regulations are primarily concerned with the administrative rather than the technical side of intercommunication facilities.

There are, however, three technical committees recognised by the Conventions and Regulations, known respectively as the International Telephone Consultative Committee (CCIF), inaugurated in 1924 (Paris); the International Telegraph Consultative Committee (CCIT), inaugurated in 1926 (Berlin); the International Radio Consultative Committee (CCIR), inaugurated in 1929 (Hague); charged with the study of technical questions relative to the methods of working communication channels; and it is from the operation of these technical committees that the international framework is built up.

* * *

Having indicated the broad framework under which international communications are at present regulated, we now come to the consideration of the probable trend of development in the future and of how far the framework will meet the needs.

It may well be that the Conventions, as distinct from the Regulations, are so broad in their principles that they will continue to serve as the basis. The same considerations apply to the Telephone and Telegraph Regulations, with probably some additional regulations to cover new systems of working which are suitable for adoption internationally. It is, however, certain that as far as the Radiotelegraph Regulations are concerned, modifications must be made to adjust the frequency allocations to meet new conditions.

The most difficult and controversial question at all International Communication Conferences since the Washington Radiotelegraph Convention, 1927, has been that of frequency allocations. These difficulties have been largely due to the adoption of different groups of frequencies in different countries for broadcasting and aeronautical services, and to the conflict between mobile services and broadcasting interests in demands for frequency allocations free from mutual interference. For example, the United States, Russia, and the rest of Europe have adopted different ranges of frequencies for aeronautical and broadcasting services, and the non-maritime nations have made many claims and encroached on the frequencies first used for ship communications. This problem of allocation can be solved only if it is treated on a rational and engineering basis. It has been complicated in the past by political considerations which have been both irrational and divorced from a technical basis.

Telephony

International telephony is still very limited in its scope; it is now possible to look forward to a great expansion. It is true that any telephone subscriber in this country may be connected to a subscriber in America, Australia, or elsewhere beyond Europe if a radio link is available. The limitations result from the small number of channels: five to the United States of America, one to Australia, India, Canada, and South Africa. There are also inherent difficulties in long-distance radio transmission, since over very long distances continuous communication on any frequency is impossible and for certain portions of the day no frequency is effective. For these reasons communication between continents relying on radio is little developed compared with transcontinental telephony where a line network exists. Compared with the five radio links from this country to the United States, there were about 200 circuits on cables between this country and Europe, including as many as 60 to Paris, 21 to Amsterdam, and 15 to Brussels. Between many countries where line connections are possible very meagre facilities in fact exist. The development of long-distance telephony in Europe itself is mainly concentrated in Middle and Western Europe. Only one direct circuit existed, for example, between London and Moscow, and none to Greece, Turkey, and the Balkan States.

* * *

Here within Europe must be great opportunities for expansion of the international telephone service. An index of one telephone circuit between London and Moscow is a poor criterion of the community of interest between the two countries. Such an expansion can, however, only be contemplated with the adoption of the most modern technique on multi-channel carrier or coaxial systems already in extensive use in some countries and ready for exploitation on a large scale. The application of carrier and coaxial technique for long-distance telephony is one of the immediate post-war questions for consideration.

* * *

Where one may anticipate the greatest development in telephony is, however, in bridging continents or such distances where hitherto the attenuation on a submarine cable has rendered its use for telephony prohibitive and recourse has had to be made to radio links as an alternative. It has been suggested that improvements in the art of radio and the adoption of more rational means for the allocation and channelling of frequencies will go far towards meeting the need for these additional means of communication.

Having in mind, however, the ever-growing demands for space in the ether and the first call which must be given on this space to the mobile services, such as marine and aeronautical, whose needs cannot be met other than by radio, I feel that the ultimate demand for long-distance telephony circuits can be met only by more line circuits. Here I suggest there are two possible solutions. The first lies in the much more complete and progressive expansion of long-distance land telephone networks, and the routing of international circuits irrespective of political considerations and based on standardised practice and sound technical and economic grounds.

We regard this country as separated from the United States by nearly 2000 miles of the Atlantic Ocean, and Australia as similarly separated by vast stretches of the Indian or Pacific Ocean. If the Atlantic crossing is made *viâ* Greenland and Iceland the longest sea distance is still about 700 nautical miles, but if to connect New York and London by wire we choose a route *viâ* Alaska, the Aleutian Islands and Russia, and select suitable islands as links for submarine cables, no length of such cable would exceed about 200 nauts; and from London to Melbourne *viâ* Europe, India, Burma, the Dutch Indies, and the Timor Sea, the greatest length of submarine cable could also be about 200 nauts.

* * *

Dr. Buckley has dealt in his Kelvin Lecture with the very far-reaching possibilities that lie in front of the submerged repeater and the lines on which it is being developed in the Bell laboratories. He envisages the possibility of transatlantic cables with repeaters spaced at distances of 42 miles, giving as many as twenty-four circuits with a band width of 2000 cycles per channel. The problem of designing so many repeaters operating in tandem, energised from the shore ends of the cable, and lying in deep water, possibly up to 2000 fathoms, obviously presents many difficulties, and the final solution may well be reached by easier stages.

* * *

A repeater of the type indicated has been laid between England and Ireland on a paragutta submarine cable, and its performance is now under observation. The watertight case is in the form of a cylinder 15in. external diameter and 5ft. long, built up with boiler plate bolted to an end casting which carries glands for the "in" and "out" cables. The repeater is single ended and is laid in a "tee" off the main cable. The electrical equipment is contained in an inner brass cylinder and the amplifier unit is spring mounted. The repeater has three stages, all valves being of a standard type, selected on account of its excellent characteristics and long life. Three alternative valves are provided for each stage, and they can be used in any combination, only the valves in use being energised. The valve combinations can be set up by switching control devices at one end of the cable, or the change-over may be automatic if a valve fails, as determined by the failure of the anode current. The power is fed to the repeater from the opposite end of the cable, 0·63-ampere D.C. at 200 volts being used. The three valve heaters are connected in series. The amplifier gain is 70 db. at 504 kilocycles. There is approximately 28 db. of negative feedback at all working frequencies. Equalisation is in the feedback circuit and the output level is about −5 db. The repeater housing has been tested to 800 lb. per square inch, corresponding to 270 fathoms. The actual depth at which the repeater is lying is 32 fathoms.

The weight of the complete repeater is 18 cwt. It was laid and jointed in the cable by one of the Post Office telegraph ships, and, despite some interruption due to bad weather, the laying operation was carried out satisfactorily without damage to the repeater. So far the performance of the repeater has been entirely satisfactory and its character-

* Presidential Address to Institution of Electrical Engineers. October 7th, 1943. Excerpts.

istics under water have been maintained without change. The experiment gives every indication of success, although a long trial is necessary before coming to final conclusions.

Telegraphy

Modern telegraphy is now tending to become wholly of a nature such that transmission between distances which are not short is by voice-frequency methods, allowing up to eighteen channels of communication to be passed simultaneously over a pair of wires, and where the transmitting agent is a teleprinter. To allow of international working it is, of course, essential that the terminal apparatus at each end should behave in a similar manner; and at quite an early stage in the developments associated with the introduction of the teleprinter and the multi-channel voice-frequency method of linking terminal points, the discussions of the CCIT enabled agreed fundamentals to be laid down, to which both teleprinters and voice-frequency systems destined for international working should subscribe.

* * *

It is unfortunate that the standards adopted by the CCIT are not universally applied. Practice in the United States, the other great user of the teleprinter and voice-frequency telegraph system, has developed independently and does not conform to the CCIT standards in the essential features of either. Thus the band speed of the teleprinter, certain essentials of the alphabet and the letters per line for column printing are not the same as those recommended by the CCIT. The frequency spacing of the voice-frequency system is 170 cycles, and thus the channel capacity per pair of wires is less than that used in Europe.

The extension of multi-channel teleprinter operation to much longer distance by radio telegraph circuits or cables may be expected to develop extensively after the war and become more international in character. It is essential that the terminal equipments should be the same, and thus there is an added argument that the co-ordination should be extended in the future to cover world-wide activities rather than, as in the past, a field which in effect only covered Europe.

Radio

It is necessary to regulate radio internationally to a much greater extent than line telegraphy or telephony, by reason of the possibility of interference over long distances. The practicability of using relay stations, *i.e.*, a receiving station associated with a re-transmission station, in order to extend the transmission distances of short and very short wavelengths, accentuates the need for agreement on allocation. Applied to short wavelengths, the use of one or two radio relay stations enables stabilisation of radiotelegraph and radiotelephone services to be obtained over much longer periods in the twenty-four hours of the day and through the variable conditions of different seasons of the year. With the very short wavelengths where the transmission distance is normally not much in excess of optical range, the adoption of relays may enormously extend this distance.

* * *

Hitherto one of the greatest difficulties in determining a frequency allocation has been political, more markedly shown in the question of broadcasting facilities than any other application of radio. Radical changes are necessary in the present allocations, and the further developments in the higher range of frequencies have brought forward both greater possibilities and more potential users. It seems that a reasonable solution can only lie in the establishment of some order of priority of user. It will be necessary to take into account such factors as the paramount need for wireless as a means of communication with mobile services, marine and aeronautical, for which no alternative is available. The needs of long-distance telegraph, telephone, and broadcasting services must also be met by radio until further development of line facilities makes their partial or complete replacement possible. These and other existing requirements, together with the new applications of wireless which have been opened up as the result of special war developments, necessitate many adjustments and extensions in the present order or lack of order in the wavelength allocations.

Television

It is with a developing and expanding art such as television that international regulation and standardisation require most careful and judicious planning. Too early crystallisation will cramp development, but lack of co-ordination may lead to chaos. It is perhaps not too much to hope that some of the mistakes in the regulation of broadcasting may be avoided, and that such international regulation as may be necessary may be applied to act, not only in the interests of television, but in the interests of other services requiring to use a similar range of frequencies in the available spectrum.

How far the full exploitation of television will be divided between radio and line transmission has yet to be determined. The use of very much higher frequencies involves limits in the effective transmission coverage of radio. Transmission, where necessary over long distances, may be by radio relays or by wire, using one of the forms of coaxial cable. How far the employment of micro-waves for radio transmission or the new mechanism of electrical transmission by wave guides will meet the needs of television is one of the intriguing problems of the future.

The Future of the Chemical Industry

An address on the future of the chemical industry was given by Lord McGowan (Imperial Chemical Industries, Ltd.) at a joint meeting of the Chemical Engineering Group, the Institution of Chemical Engineers, and the London Section of the Society of Chemical Industry, on Tuesday, October 12th, at the Institution of Mechanical Engineers, London.

If, he said, the chemical industry was to discharge its responsibility as one of the great servants of the community, it must be granted the opportunity to earn, in the face of all fair competition at home and abroad, enough to enable it to reward its workers adequately, to apply adequate funds to research and development, to provide the public with the best article at the right price, and to yield a fair return to the shareholders who had adventured their money in it.

Research

The basic requirement was that means must be found to create and maintain the maximum flow of inventions. Only if research was fostered in the most effective possible way would it be possible for us to avoid degenerating into copyists—which we could not afford to do. Without subscribing to comparisons that were made between the amount of money spent in America and in Russia for the benefit of industry and agriculture, and in this country—it having been stated that the expenditure in Great Britain was only one-tenth of that in the U.S.A.—because such comparisons could be most misleading if they were made on different bases, he felt most strongly that both as a nation and as an industry there was the greatest necessity for a large increase in our research effort. The total research effort in Great Britain was shared between the universities, industry, and the Government; but he suggested that the present was an opportune time to consider the closer definition of the functions of those three parties, if wasteful overlapping was to be avoided and if the effort made was to achieve the best results. The main function of the universities was to train and turn out for the benefit of the community the best type of research worker. All other considerations should be subservient to this end. The essential aim should consist of the study of fundamental problems aiming at an extension of our knowledge of the laws of Nature. At the same time, it would be a great advantage to both sides if the universities and industry maintained closer personal contact, and means by which this closer association of industrial and university workers could be achieved should not be difficult to find.

Outside the scope of fundamental and industrial research was the vast body of work which must be done under Government auspices, from which the community as a whole benefited, but which were too far from being straightforward commercial propositions to be undertaken by any independent concern or even by a research association. The most outstanding example of what he had in mind was coal. The coal picture here to-day was anything but satisfactory, for we were making deep inroads into our deposits of easily won and high-quality coal while mining costs were still rising in a spectacular fashion. It was worth while remembering two unpalatable facts. One was that during the past six years the cost of winning coal in this country had risen by no less than 70 per cent., and by all the current indications still further increases must be expected. The second was that pit prices of coal in the U.S.A. were lower than corresponding prices in this country by an amount equivalent to about 10s. per ton, *i.e.*, U.S.A. prices were cheaper than ours by an amount which was little less than our total pre-war cost of coal at the pit.

Whether or not the chemical industry and, indeed, the whole of British industry could stand such an immense handicap in the race for production, even in the home market, might be a matter for argument, but there could be no doubt of the danger it represented to our export trade.

Patents

A further point of much importance to industry concerned patents and their exploitation. There appeared to be a feeling that because companies and individuals could at present obtain exclusive licences for a particular process they were in a position either to sell the product at a higher price or suppress it altogether if it threatened processes in which they were already interested. It had been suggested that the system of exclusive licences should be abolished and superseded by one of non-exclusive licences obtainable as a right by all wishing to secure them. That proposal had been made with the worthy aim of assisting the national effort, but he was sure its adoption would have precisely the opposite effect. The grant of non-exclusive licences would lead direct to unrestricted competition and to manufacture in small units and at high costs. It would also lead to a great increase in the operation of inventions as secret processes, with the most unfortunate effect. In general, said Lord McGowan, there was an insufficient realisation of the fact that matters such as he had discussed had been foreseen and remedies for abuses had been provided on an ample scale in the Patents Act itself. Should any abuses which had not been foreseen make their appearance—and he was not aware of any—the remedy was to obtain an extension of the existing safeguards and not seek to effect any revolutionary changes which, in his view, would do far more harm than good.

Development

Another aspect of the chemical industry which should receive more careful consideration in the future was what he called, for want of a better name, "development," viz., the con-

version of research results into commercial processes. There must be collaboration with potential consumers in order to assess the merits of the product and to determine the most advantageous form in which to produce it. Another important duty of a development organisation was to decide at what point any given research was ready for commercial exploitation. Let us forget the slogan "Safety First." Britain stood where it did to-day through the courage shown by our predecessors—an example we should follow. Research and development, although distinct in their functions, were so closely interlocked that it was frequently impossible to tell where one ended and the other began, and there was therefore all the more necessity for the two organisations to work together as a team. In other words, those engaged in development must work in the closest possible collaboration with the research personnel.

Social Problems

Referring to the human and social responsibilities of the industry, especially towards the working man, Lord McGowan said that if they were to maintain their right and proper place in the vanguard of employers and industrialists of the country, it was incumbent upon them to reward adequately workers in industry and to provide conditions for them that we could be proud of. "Reward" included other features than the mere payment of wages and salaries. Security, opportunity, and environment all played a large part in a man's working life and had a material bearing not only upon his happiness, but upon his efficiency. Increased measures of security while working and when retired might well form part of the State's policy after the war, but industrialists could and should supplement such State facilities up to the limit of their abilities.

Much had already been done, but still more remained to be accomplished to ensure co-operation and confidence between employers and employed, and he looked forward to an extension of Works Councils, Whitley Councils, and the Joint Production Committees, all of which had played an important part in the development of this spirit and had made a valuable contribution to the war effort.

Conservation of Wood*

By ALBERT G. H. DIETZ†

Wood has become a strategic material in the war effort, both in its own right and as a replacement for other materials needed elsewhere. The demand is so great that it must be used judiciously in order to make the available supplies go as far as possible. Two approaches to conservation can be followed:—First, to increase the allowable fibre stresses; and, secondly, to employ the new techniques in the use of wood which have evolved during the past fifteen to twenty years, and which generally reduce the amount required for structural purposes.

Allowable Fibre Stresses

Basic Considerations.—In order to obtain the maximum usefulness from structural materials, particularly in buildings of a temporary nature, the trend is toward an increase in the allowable fibre stresses or a decrease in the live load requirements, or both. Such changes, particularly increases in allowable stresses, require a re-examination of the bases upon which working stresses are established. In the case of wood, this calls for consideration of the effect of time—rate of loading and duration of load—upon the strength of wooden beams.

In Fig. 1 the Forest Products Laboratory's load-time curves are reproduced. The curves show the variations in stress at proportional limit and in modulus of rupture as a percentage of the values obtained under standard loading conditions, which generally take approximately five minutes from first application of load to failure. If the standard test values are taken as 100, an increase in the loading rate increases the strength, which approaches 150 per cent. for impact, whereas lower loading rates decrease the strength to as low as 60 to 65 per cent. for loads applied over unlimited periods. The proportional limit of wood is approximately 60 per cent. of the modulus of rupture, depending upon the species and the type of load. To be conservative, the figure is often taken as nine-sixteenths, and this is also considered to be the breaking strength if the load is applied uninterruptedly for very long periods such as forty or fifty years.

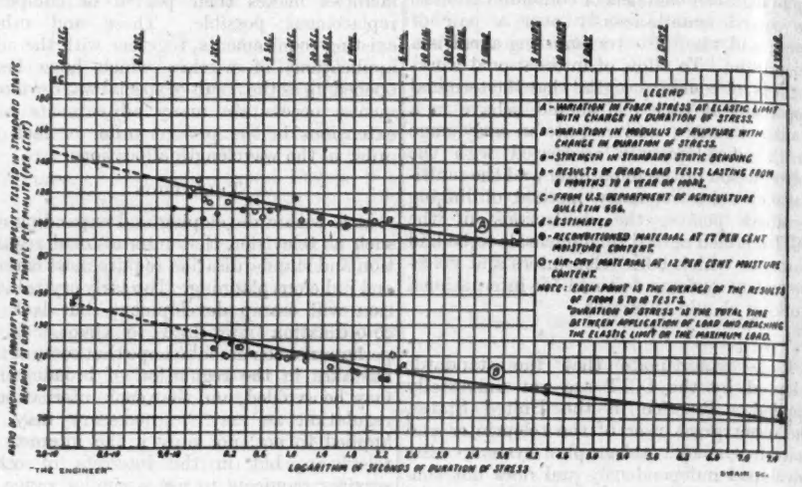
LEGEND
A - VARIATION IN FIBER STRESS AT ELASTIC LIMIT WITH CHANGE IN DURATION OF STRESS.
B - VARIATION IN MODULUS OF RUPTURE WITH CHANGE IN DURATION OF STRESS.
a - STRENGTH IN STANDARD STATIC BENDING
b - RESULTS OF DEAD-LOAD TESTS LASTING FROM 6 MONTHS TO A YEAR OR MORE.
c - FROM U.S. DEPARTMENT OF AGRICULTURE BULLETIN 556.
d - ESTIMATED
e - RECONDITIONED MATERIAL AT 17 PER CENT MOISTURE CONTENT.
o - AIR-DRY MATERIAL AT 12 PER CENT MOISTURE CONTENT.
NOTE: EACH POINT IS THE AVERAGE OF THE RESULTS OF FROM 6 TO 10 TESTS.
"DURATION OF STRESS" IS THE TOTAL TIME BETWEEN APPLICATION OF LOAD AND REACHING THE ELASTIC LIMIT OR THE MAXIMUM LOAD.
RATIO OF MECHANICAL PROPERTY TO SIMILAR PROPERTY TESTED IN STANDARD STATIC BENDING AT RATE OF TRAVEL PER MINUTE (PER CENT)
LOGARITHM OF SECONDS OF DURATION OF STRESS
"THE ENGINEER"

Fig. 1—*Load-Time Curves for Beams*

Working stresses are derived for any particular species by considering the natural variability in the strength of wood and the effect of time and by applying a factor of safety. The usual procedure is first to obtain an average modulus of rupture figure for small, clear, perfect specimens. This is reduced 25 per cent. for variability, is multiplied by nine-sixteenths to take care of long-continued loads, and is divided by 1¾ as a factor of safety. For structural timbers a further reduction of 10 per cent. is made to allow for the effect of depth, since a beam 12in. deep has a modulus of rupture approximately 10 per cent. less than a standard test specimen 2in. deep. The final figure, called a "basic stress," represents the working stress for perfect timber. Actual commercial timbers are assigned working stresses less than the basic stresses, depending upon the nature and extent of characteristics such as knots, diagonal grain, and shakes or checks. Although dry timber is considerably stronger than is green, both green and dry timber are assigned the same allowable stresses because large timbers usually season in place, and may develop seasoning defects which offset the increase in strength brought about by drying.

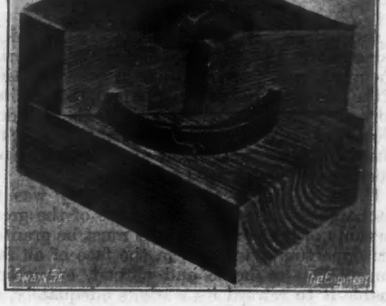

Fig. 2—*Split-Ring Timber Connector*

It is to be noted that "basic stresses" for shear, compression, and tension, all parallel to the grain, and for compression perpendicular to the grain, are based upon the same line of reasoning. It is problematical whether time has the same effect upon these stresses as upon bending stresses and the inclusion of the nine-sixteenths factor would appear to be well on the safe side. On the other hand, commercial grading procedure is largely based upon beams, and coarser defects are sometimes permitted at the ends of pieces than at the centre. This has an adverse effect upon members acting in direct tension and compression, and the inclusion of the nine-sixteenths factor consequently is a safeguard for such pieces.

For temporary structures, having a life of a few years at most, and for structures in which full loads are applied only intermittently, working stresses can be increased without reducing the overall factor of safety, inasmuch as the working stresses usually assigned are based upon the assumption that loads are applied continuously for an indefinite period. It appears probable that an increase of 25 per cent. does not decrease the safety factor for short-lived structures or for any structures in which full loads are applied for only several days at a time. An increase of 33 per cent. decreases the overall safety factor only slightly for such structures.

Mixed Species and Grades.—Engineers accustomed to working with materials possessing uniform strength properties are prone to overlook the conservation possibilities in using different species and different stress grades for various parts of their structures. In many structures relatively few members are stressed to their full capacity; convenience often dictates the use of uniform sizes, and end connections sometimes require oversized members. Such understressed members can often advantageously be lower-strength species, or lower-stress grades of the same species employed for the highly stressed members. For example, if certain members of a structure call for 1600ft. yellow pine or Douglas fir, whereas 1100ft. or 1200ft. would do perfectly well for the others, the lower-stressed members could well be lower-grade yellow pine or Douglas fir, or some other lower-stress structural species, such as spruce or hemlock. Although mixing grades and species might call for rigid field control, instances frequently arise in which the differently stressed members are different in size, and the possibility of using the wrong pieces is almost automatically eliminated.

Modern Timber Construction Techniques

The past fifteen or twenty years have witnessed the advent and rapid development of a number of new techniques which have considerably simplified and reduced the cost of wood construction, and which more nearly utilise the full strength of wooden members than did the older methods. These techniques are extremely important to-day, inasmuch as, properly employed, they reduce the amount of

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wood required for many structures and increase the speed of construction at the same time.

Timber Connectors.—By all odds, as far as the war effort is concerned, the most important single contribution to timber structures is the timber connector, first developed in Germany and Sweden during and immediately following the last world war, and introduced into the United States during the early nineteen-thirties. Although timber connectors of various types are in use, such as the toothed ring, spike grid, shear plate, and split ring, the most commonly employed is the split ring, illustrated in Fig. 2. This is a circular band of steel, provided with a split, which is embedded in pre-cut grooves, half its width in one member and half in the adjacent one. The split permits the ring to open slightly under load, so that both the inside and outside bear against the wood. The ring spreads the load transmitted from one member to another over a much larger area than would a bolt; consequently, it reduces the tendency to crush the wood and therefore increases markedly the strength of the joint.

The prime advantage of the timber connector is that a much larger percentage of the full strength of framing members can be developed than by traditional methods of construction and the amount of material required can therefore be reduced. A second advantage of the connector is that relatively small thin pieces can be employed and large members can be built up by overlapping and splicing. Since high-grade material is more readily available in smaller sizes, a conservation advantage results. Furthermore, a larger percentage of the log can be made to yield high-grade stock if pieces are small, because local defects can be cut out during manufacture.

A third advantage is the simplicity of framing. As shown in Figs. 3 and 5, framing members, such as chords and web members of trusses, need only be cut to length, usually with a simple square cut, bolt holes bored, ring grooves cut, and the structure assembled. Power tools speed up the operations and much of the work can be performed by semi-skilled labour. Frequently all parts are prefabricated to template in a shop and are shipped to the site. It is interesting to note in Fig. 5 that the top chord members have been band-sawn to the shape of a bowstring, a shape inherently economical of material, particularly for large spans. Upper chords of bowstring trusses are frequently laminated.

Timber-connectored structures are increasing in size and complexity. Arch trusses spanning 250ft. have been built and larger ones are in prospect.

Glued Laminated Construction.—Although glued, laminated members, both straight and curved, have been used in Europe since about the turn of the century, their adoption in the United States has become fairly widespread only within the past few years. They possess inherent advantages, however, particularly in the economical use of materials, which are especially important from the standpoint of conservation. These advantages are twofold: First, the shape of the members can be made to conform to the most economical shape for the structure; and secondly, high-strength and low-strength material can be employed to best advantage.

For large spans the most economical form is frequently an arch. Since deep members can be built up of many thin ones bent to shape and glued together, almost any curvature can be obtained by simply making the laminæ thin enough, and any size of member can be fabricated by using enough pieces. Once glued up, the member retains its shape and is relatively unaffected by changes in moisture content.

Inasmuch as many structural members such as beams are stressed to their maxima in localised areas only and are much more lightly stressed elsewhere, laminated construction permits relatively small amounts of high-strength, high-grade material to be used where it is required, and lower-quality stock where great strength is not necessary. Much better utilisation of wood results, and conservation is aided. Furthermore, easily dried thin material and short lengths (usually hard to utilise) can readily be employed. Finally, the fairly massive members which result are excellent from the standpoint of fire resistance.

Glue most commonly employed to-day is water-resistant casein. Although the cold-setting synthetic resins are generally more water resistant, their present working life after spreading is fairly short, too short for large laminated parts. However, their use is increasing, particularly where high water resistance is required, as in ships' keels.

Laminated beams, 60ft. to 70ft. long and arches spanning more than 160ft. have been fabricated. Eighty-foot arches for an aircraft hangar are illustrated in Fig. 4. The individual sections consist of twenty-six laminæ of 1in. by 6in. boards.

Plywood.—Plywood is relatively new in the heavy structural field, but has long been employed in the aircraft industry for webs in strong, light-weight spars and for gusset plates.

Recently, a number of heavy structural girders and arches employing plywood webs have demonstrated marked economies both in fabricating costs and in the use of materials, and deserve careful consideration from the standpoint of conservation. A noteworthy example is the plate girders shown in Fig. 6. These have laminated wooden flanges and solid wooden stiffeners covered with plywood webs, the whole assembly forming a box girder. No glue is used; the flange sections are held together by toothed-ring timber connectors, and the plywood webs are nailed to the flanges and stiffeners with cement-coated nails. Girders are carried on posts by timber connectors. By careful dimensioning, standard plywood sheets were cut so as to leave no waste.

Economical floor and roof panels are being constructed by nail-gluing plywood sheets top and bottom to joists or rafters. Strength is increased at the same time that material required is reduced. Heavy plywood has also been employed for gusset plates in timber-connectored trusses, a use which may be expected to increase.

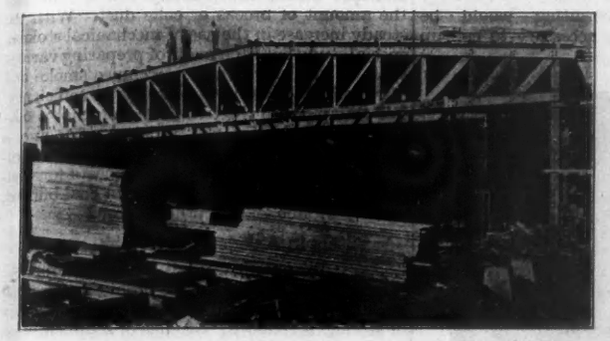

FIG. 3—*100ft. Flat-Top Pratt Trusses Framed with Split-Ring Timber Connectors*

FIG. 4—*Laminated Glued Arches*

FIG. 5—*Timber-Connectored Bowstring Trusses*

FIG. 6—*36ft. Span Plate Girders*

SUMMARY

Wood has become a strategic material in the war effort, the demands are heavy, and it must be employed judicially. For temporary structures and structures loaded only intermittently increases in working stresses up to 25 per cent. are permissible without markedly altering the margin of safety. Increases up to 33 per cent. probably do not reduce the factor of safety

appreciably. Increased working stresses, wisely employed, conserve materials. Conservation can also be aided by employing the newer construction techniques developed during the past fifteen to twenty years. Of these, the timber connector is outstanding. Laminating, plywood, and glued construction in general are also able to effect marked economies.

17-Pounder Anti-Tank Gun

The accompanying engraving illustrates a British anti-tank gun. It is the 17-pounder. The weapon measures 24ft. from muzzle to trail and semi-automatic breech action gives it a very high rate of fire. The muzzle brake, visible in the engraving, absorbs a considerable proportion of the recoil. A split trail provides

17-Pounder Anti-Tank Gun

for the wide traverse so necessary when firing at moving objects, such as tanks. Fixed ammunition, that is, ammunition in which shell and cartridge are fitted together, is used.

The gun was designed, we understand, not to meet conditions of warfare existing at that time, but as a counter to anticipated developments in the design of German tanks, and it is a remarkable coincidence that an example first went into action, though not on the same sector of the fighting front, on the same day that a German "Tiger" tank first operated against us. The designers believed that the next development of the German tank would be, as has actually proved to be the case, in the direction of very heavy armour and big guns at the expense of mobility. The new weapon can knock out even such heavily armoured tanks as the "Tiger" at ranges up to 1000 yards. Reports speak highly of its accuracy and its performance against the enemy appears to have been highly satisfactory.

The Future of the Coal Industry

In the House of Commons, on Tuesday, October 12th, Major Lloyd George, the Minister of Fuel and Power, reviewed the position in the coal mining industry and dealt with some of the problems of its future development. At the outset he said that at the beginning of the fifth year of war the miners and colliery managements had not yet failed to win the coal needed for the conduct of the war and the reasonable comfort of our homes. This country could not, he continued, deal with all the demands which were likely to arise. Committees of the Combined Production and Resources Board had been established in London and Washington to mobilise the coal resources of the United Nations. Our efforts in fuel saving must equal those of last year—at least. Dealing with the return of miners to the pits, Major Lloyd George stated that during the last two years over 60,000 ex-miners had returned from other industries and the Forces to the mining industry. The Government was taking steps to institute a comb-out of miners in the Army, particularly of the older men, with a view to their return to the mines. It had been proposed by the Minister of Labour to raise the labour force in the mines to a minimum of 720,000 men. That figure would have to be retained, in view of the net annual wastage from which the industry suffered. Voluntary recruiting would be retained, but it would be necessary to call up men for the coal mines in the same way as they were called up for the Armed Forces. The upgrading system had been responsible for increasing the numbers of men at the face last year by 6000. Another factor playing an important part was the production of outcrop coal, which was running at roughly double what it was last year and would be again doubled this year. A proposal in the report of Lord Greene was that in future the output bonus scheme should be on a pit basis in order to increase the incentive of the individual miner. The Government was prepared to provide the necessary financial and administrative machinery to work the new system. The first task of the Government was to achieve better coal production. There could be no question of the removal of control until Parliament had determined the future structure of the industry.

American Engineering News

Bituminous Coal Research

Recent procedure of American research in the higher efficiency and economy of coal production and use by the State Geological Department of Illinois—which is one of the largest producers of bituminous coal—has covered three important lines of investigation: —First, smokeless briquettes; secondly, coke for metallurgical and domestic purposes; and thirdly, the preparation of stoker coals of greater efficiency. A special plant for the manufacture of briquettes has been completed, using the Piersol process and employing a photo-electric cell or "electric eye" for measuring the amount of smoke given off by experimental briquettes. By prevolatilisation of the ground coal, the resultant briquettes are practically smokeless, and it appears that the fine dust from the de-duster—ordinarily a waste product—is useful in making smokeless briquettes. Difficulty has been experienced in getting satisfactory dies of alloy steel, several of which were too brittle to stand the high temperature and pressure. The coke or coking investigation has two main objectives:—First, the production of domestic coke to meet the demands for smokeless fuels; and, secondly, the production of metallurgical coke from blends of low-sulphur high-volatile coals and other coals of low volatility. The latter, in proportions of 25 to 30 per cent., increase the strength and weight, and also reduce the porosity of the coke and the amount of breeze or coke dust. With the steady increase in the use of mechanical stokers, special study has been made of preparing various coals in such a way as to minimise smoke and dirt, while increasing the combustion efficiency. For this purpose the test laboratory has a concentrating table of the Deister type, and a stoker-fired boiler equipped with control instruments and automatic recording charts for temperatures, air pressures, amount of coal burned, density of smoke, and other factors.

Silting in American Reservoirs

In practically all reservoirs for the storage of water there is the problem of gradual sedimentation or silting by which the capacity of storage is reduced. Studies of sedimentation rates permit only of very approximate rates, but even these may be of use in design by engineers who must allow for inevitable depletion of storage. But, according to a recent paper before the American Society of Civil Engineers, the real solution of the problem lies in the prevention of sedimentation and in the greatest possible conservation of the available storage. Factors for study include the nature and origin of the sediment; its transportation to and through—or deposition in—the reservoir; and remedies to prevent silting. Some streams always have a heavy silt burden, others are troublesome only during floods. Where sedimentation is beyond control, excess storage space must be provided to compensate for depletion by silting during a reasonable economic lifetime. While removal of accumulated silt by mechanical excavation is highly expensive, it has been found feasible in California because of the severe damage done by *débris* flows from arid and eroded watersheds. Sluicing through small gates to cut away the deposit is rarely effective, and sluicing through large flood gates only passes on the problem to downstream areas. Prevention of erosion appears to be the best means of minimising the silting. It may include reforestation, check dams in gullies, contour ploughing, and stabilising of banks of streams. The necessary research and the collection of data are slow and expensive, but it is considered that the return may reasonably be expected to justify the expense. In fact, it appears doubtful that the total cost of such research up to the present time exceeds a very small percentage of the value of irreplaceable reservoir capacity already destroyed by sedimentation. While preventative methods are the more expensive, they include also an important sociological problem that should not be ignored.

New Iron and Steel Plants in China.—The first of the blast-furnaces under construction by the Nippon Steel Tube Company, near Tsingtao, in Occupied China, has been completed a month ahead of schedule.—Licences have been received by the Nippon Seitesu concern, the largest iron and steel-producing firm in Japan, to begin production of basic Bessemer steel, formerly a monopoly of the Japan Steel Tube Company.—Registration of a company in Peking (the North China Iron Manufacturing Company) is reported. Capitalised at 100 million yen, equal amounts are subscribed by the Japan Iron Manufacturing Company and the North China Development Company. The new company will erect and operate an iron and steel industry in Tientsin and will attempt to concentrate the East Asian iron and steel industry under a single control.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer.

Iron and Steel in the United States

In the United States the production of iron and steel on the whole is well maintained and large tonnages are passing into war production. At Buffalo a blast-furnace of 1250 tons capacity has been in operation for three months and three other blast-furnaces which have been idle for relining during the whole of the third quarter will probably resume work in October. Two furnaces in the Youngstown district have been laid idle for relining, but twenty-four of the total twenty-six in that locality are operating. In the Birmingham, Alabama, district twenty furnaces are active and only one is idle for relining. A quiet demand for pig iron is reported from New England, and only a moderate business has passed with the stove foundry industry, which is usually an important buyer at this time of the year. It is possible that the demand for higher prices for Lake ores may lead to an advance in pig iron prices early next year if the present demand is maintained. The current production of steel averages 100·3 per cent. of capacity and equals 1,748,200 tons per week of ingots. The reports from the districts state that Pittsburgh works are operating at 100 per cent. and that additional new capacity is expected to come into production shortly. At Chicago operations are at 99 per cent. In this district large deliveries have been made of finished steel, particularly of sheets and plates. Operations in the Youngstown area are at 97 per cent. of capacity and seventy-six of the eighty-three open-hearth furnaces in the district are in operation. It is reported that the Carnegie-Illinois Steel Corporation, the leading subsidiary of the United States Steel Corporation, achieved a production in August in excess of all previous figures. This was in response to the Government's call for an additional 2 million tons of steel for delivery next year. The company's record in August was 1,962,623 tons, in spite of unusually hot weather. The entire United States steel industry's production in August totalled 7,562,125 tons ingots. This compares with a record for March, 1943, of 7,670,187 tons.

The Pig Iron Market

Increased supplies of ore from North Africa and the consequent larger production of medium and low-phosphoric pig iron have considerably eased the supply position of this description. In particular, more liberal supplies have been made available to meet the demand of the general engineering foundries. Some relaxation in the demand also has contributed to easing the position, and consumers now seem able to obtain nearly all the medium and low-phosphoric pig iron they require. There is an insistent demand for hematite, which cannot be fully met, and the Control is obliged to keep a careful eye upon the distribution of this kind. In fact, hematite is not released unless its use is essential. Consumers hope, however, that with larger supplies of high-grade ore reaching the country the production of hematite will be increased to a point at which it will fully meet the demand. So far the increased supplies have been largely distributed to the engineering foundries. These, almost without exception, are employed in the production of castings needed for Government contracts. There is little improvement to be seen in the light castings industry, but here and there foundries employed upon light castings appear to be rather better off for work than for some time. This branch of the industry normally is the largest user of high-phosphoric pig iron and liberal supplies of this kind are available. Recently licences have been granted somewhat freely. The steel works continue to absorb large quantities of basic pig iron, but the production of this iron is on a scale which fully meets the demand. Engineering foundries are also calling for considerable supplies of special irons, particularly the machine tool makers, but the demand in this department is not so urgent as it was only a few weeks ago. In nearly all departments of the pig iron market there has been some decline noticeable in the demand over the last week or two. This seems to be due principally to alterations in the war production programme, and the falling-off seems to be chiefly in the demand for foundry pig iron. The volume of new business reaching the foundries lately is less than the contracts which have been worked off.

Scotland and the North

The Scottish steel works are fully employed in meeting the intense demand for steel for war purposes. Most of them have sold their output until the end of the year and few have more than a small capacity for any further orders which consumers may seek to place for delivery before the early part of 1944. The big programme under way at the shipyards is causing continuous pressure for plates, which are also in request by the marine engineers, wagon and locomotive builders. These consuming industries are almost fully employed upon Government contracts. A big volume of business has been transacted in steel bars; the larger sizes have been taken up in considerable quantities by the engineering concerns, and there is an insistent demand for small steel bars which is keeping the re-rolling works busily engaged. The latter are also producing large quantities of small sections and in the majority of cases are unable to promise delivery before the end of the year. There is, however, only a moderate request for the heavier sizes of joists and sections, and it is possible to place orders for these for delivery within a reasonable period. A satisfactory feature of the steel position is that supplies of semi-finished steel are being received regularly by the works. There is a heavy demand for billets, whilst sheet bars are also wanted in important quantities. It is understood that good stocks of imported materials are being held by the Control, but these are sparingly released and are not required to the same extent now that the home production of billets and sheet bars has been considerably increased. Sheet makers' order books for heavy and light sheets are congested and they are also turning out considerable quantities of thin plates in order to relieve the pressure upon the plate makers. Operations are maintained at a high level by the Lancashire steel industry and a steady business is passing in alloy steel. The demand for this description may not be so strong as some months ago, but steady quantities are passing into consumption at the engineering works, while for special-quality steel some makers quote three months for delivery. Some tightness has developed in the supplies of large-diameter bars, but this is regarded as being only a temporary phase. The insistent demand for plates shows no relaxation and the resources of the producing works are taxed to meet consumers' requirements. Great activity prevails at the steel works on the North-West Coast. Production is at a high level and deliveries are well maintained.

Midlands and South Wales

Although the Midland iron and steel industry is facing a period of intensive working over several months, there is complete confidence that the works will be able satisfactorily to meet the demand. Encouragement is found in the raw materials situation, which appears to be completely satisfactory, and there seems to be no likelihood of a shortage developing in any department. The semi-finished steel position is comfortable. Supplies of billets, blooms, and sheet bars are reaching the works on a fairly liberal scale, and the larger production of this material has provided more defectives and crops. In some districts a slight difficulty has been experienced in disposing of the full output of defectives. There has been no decline in the consumption of plates. The shipbuilding industry, wagon builders, tank builders, and marine engineers continue to take large tonnages and there has been a big demand for boiler plates. The demand for sections has broadened, although it is concentrated principally upon the lighter sizes. Most of the works producing medium and light sections have enough orders on their books to keep them busy for many weeks. The volume of business in heavy sections, however, does not improve, and consumers find little difficulty in placing orders for comparatively near delivery. There is a strong demand for bars of all sizes and the re-rolling industry is turning out light bars on a heavy scale. Recently some of the works have found that new business coming to hand has not been sufficient to make good the orders completed. Business in shell steel bars is quiet after a period of activity. There is a strong demand for the larger diameter bars from the engineering industry. Iron bars are in moderate request and there has been only a quiet demand for best bars. There is a steady demand for Nos. 3 and 4 bars and for Crown bars. Pressure is maintained on the iron and steel works in South Wales, most of which are operating at capacity. The tinplate trade is comparatively quiet, but recently there has been an improvement in the inquiry in the home market. Practically no business of consequence has been transacted in the export market. The works, however, are taking up their allocations of sheet and tinplate bars and there is a steady business passing in sheet bars. In the finished steel department the pressure is principally for plates, but the volume of business in structural steel is steadily expanding and most of the works producing the lighter sections are fully employed. The sheet works also have enough work to keep them busy until after the end of the year.

The North-East Coast and Yorkshire

All the steel works on the North-East Coast are assured of busy conditions until the end of the year and many of them have booked extensive contracts lasting well into 1944. The semi-finished steel position is satisfactory, on the whole, but the re-rolling works are heavily booked and their requirements of billets are large, whilst there is a strong demand also for blooms and slabs. The recent increase in the production of semis has considerably eased the position and there is no real stringency at the moment, but it is still necessary for re-rollers to use substitute material in the shape of defectives, crops, &c., while in some cases the Control has released supplies from stocks of imported material. These withdrawals from stock, however, are on a much lesser scale than earlier in the year. The plate position is unaltered. The demand has not relaxed and the works producing this material are operating at full stretch. The greater part of the production goes to the shipyards, but recently orders which have been given out by the Ministry of Transport for more locomotives and wagons have increased the demand for boiler plates. Heavy engineers also are taking up good quantities of plates and the plate mills are already booked for months ahead. The call for sections is maintained and is keeping the makers fully employed. The request, however, for the heavy sections has not improved, and fairly early delivery can be arranged for this class of material. It is for the light sections that the call is most urgent, and large quantities are being produced by the re-rolling works. Expectations are rife that there will be a considerable increase shortly in the demand for alloy steel. Up to the present users' requirements do not seem to have been more than what is regarded as normal in these days. The demand for basic steel is fully maintained and is keeping the Yorkshire steel works employed at capacity. The raw material position, however, is good and production is at a high level. Large quantities of acid carbon steel, also, are being manufactured, and are passing almost immediately into consumption. There is moderate activity in the alloy steel section and the demand, whilst not at peak levels, is sufficient to keep makers well employed. In this department the call is principally for the engineering varieties of alloy steel. There is a steady business passing in finished iron, although it does not compare with the heavy demand for steel materials.

Iron and Steel Scrap

The chief characteristics of the iron and steel scrap market change little, but recently there has been a general tendency for the demand to improve. The request is chiefly for the heavier and better qualities, but the lighter descriptions have received much more attention from consumers of late, and considerable quantities are being taken up to make good the gaps in the supplies of the heavier descriptions. Supplies of the lighter qualities are considerable, and consumers have no difficulty in filling their requirements. Good heavy mild steel scrap cut to furnace and foundry sizes is a strong feature of the market, and most consumers would be prepared to take larger quantities than are available. Bundled steel scrap and hydraulically compressed steel shearings are in active request by acid steel makers, who are feeling the scarcity of heavy material. Considerable quantities of mild steel turnings are arising and there is a slightly better request. The recent improvement in the volume of business in wrought iron and steel scrap for the basic steel furnaces is maintained. There are only moderate supplies of good heavy material, but the position has changed, inasmuch as this description is less freely offered than it was, with the result that the demand is becoming stronger. On the other hand, light material is quiet, although some dealers consider that the quantities going into use have improved. There is also a better demand for basic bundles, and these are used to supplement heavy material, which is in comparatively short supply. The demand for cast iron grades is steady and the volume of business in this quality has increased during the past few weeks. Heavy cast iron scrap in large pieces and furnace sizes is in somewhat tight supply and users are showing some eagerness to obtain good-size parcels. Light cast iron scrap is also in fair request and parcels which come on the market are quickly taken up. Good cast iron machinery scrap in cupola sizes is meeting with a strong demand and consumers are finding difficulty in obtaining all they need. The forges are readily accepting deliveries of first-grade heavy wrought iron scrap. In some districts a brisk call has sprung up for nickel-chrome steel scrap and turnings, and there has been a moderate inquiry for special S. & P. steel scrap.

Notes and Memoranda

Rail and Road

Electrification in Bulgaria.—Plans are afoot in Bulgaria for the electrification of portions of the Bulgarian railway system. Conversion will be carried out in two stages, the first of which may be termed the Sofia sections—say, 200 miles. Later, other lines may bring the programme up to 500 miles.

War on the Highways.—The Chief Engineer of the North Carolina Highway and Public Works Commission has expressed the opinion that 50,000,000 dollars and from three to four years' work will be required to put North Carolina's highways back into the shape they were before the war. Some 60,000 miles of State and county roads are affected.

Bridges as Post-War Work.—American engineers are looking to bridge building for post-war work. A typical example of the plans in progress is provided by the Louisiana State Board of Highways, which has made a beginning toward the construction of a new high-level bridge across Calcasieu River, Lake Charles, La., by authorising the sale of 2,000,000 dollars worth of bonds for completion of engineering work and acquisition of rights of way.

Alaska Highway Developments.—The Alaska Highway is completed and some 3000 Canadian workers—mainly from the Eastern Provinces—are being returned home. Now, three possible routes for a 6,000,000-dollar highway linking the main road networks of British Columbia to the new highway are being surveyed. Two survey parties are mapping out these routes for the projected highway.

Quebec Bridges to be Rebuilt.—During the past summer great damage has been caused to bridges by flood waters in the eastern district of Quebec. The Provincial Minister of Public Works, who has made a survey of the area to obtain first-hand information, has found that in all some fifty bridges—large and small, some of steel construction and others of wood—were swept away by the flood waters which also washed out large sections of highways.

Madagascar to Get a New Line.—The construction of a road bed for a railway 62 miles in length, between Antsirabe and Ambositra, has been authorised. This line, an extension of the existing Tananarivo Railway, will be situated on the high plateau in the interior of Madagascar. The section from Antsirabe to Ambositra is already covered by a highway. Bridges and other works on the new railway requiring steel are to be left in abeyance for the time being.

L.M.S. Anti-Gas Trains.—An L.M.S. breakdown train, with a special anti-gas vehicle attached, was recently rushed to the scene of a bomb and gas attack exercise. The hooded, oilskin, and respirator-clad breakdown squads quickly re-railed the obsolete and contaminated locomotive which had been plunged into a crater and rapidly repaired the track, signals, and communications. Twenty L.M.S. breakdown trains are now equipped with special anti-gas vehicles and are so situated that they can reach, in quick time, any portion of the L.M.S. system from Southend and Bristol to Thurso. These anti-gas vehicles are kept fully equipped and stocked with everything likely to be necessary for working under gas conditions. They are divided into two compartments, one for equipment and special clothing and the other for the special anti-gas squad. The second compartment is fitted with wash basins and is also used as a dressing room.

Miscellanea

Indian Timber Production.—Timber production in India has increased from 242,600 tons in 1940–41 to 396,000 tons in 1941–42, and is expected to reach a total of about 560,000 tons in 1942–43. Apart from its use in packing cases, ammunition boxes, railway ties, huts, and telegraph poles, Indian timber is extensively used for the load-carrying bodies of Army vehicles.

The British Valve Manufacturers' Association.—At the recent annual general meeting of the British Iron and Steel Valve Manufacturers' Association it was unanimously decided to extend the membership of the Association to include manufacturers of non-ferrous industrial valves and fittings and to alter the title of the Association to the British Valve Manufacturers' Association. Non-ferrous valve makers desirous of becoming members of the B.V.M.A. may obtain full particulars on application to the Secretary, Mr. H. E. Jones, 32, Victoria Street, London, S.W.1. Mr. R. A. Blakeborough—chairman of J. Blakeborough and Sons, Ltd., Brighouse, Yorks—was elected to succeed Mr. O. E. Dickinson as Chairman of the Association for the ensuing year.

Cotton Better than Leather.—The U.S.A. Signal Corps has found a new use for home-grown cotton. Because of its weight and the rough treatment it receives in war the field telephone has hitherto been carried in a heavy leather case, but after experimentation and tests at the Signal Corps laboratories at Fort Monmouth, N.J., a cotton carrying case was evolved that not only is as strong as leather, but in some respects superior. The change was made to conserve leather for footwear.

British Association for Commercial and Industrial Education.—Mr. P. A. Best presided over a well-attended meeting of the recently elected Council of the British Association for Commercial and Industrial Education, held in London on September 24th. Committees were appointed to deal with apprenticeship, foremanship training and training of operatives, statistical survey, and Government Departments and education. A sub-committee to consider and report on the Government White Paper and other reports was also appointed.

The Electrical Transformers Order.—The Board of Trade has published through H.M. Stationery Office, price 1d., the Electrical Transformers Order, 1943, which, as from September 30th, 1943, prohibits the manufacture, except under licence, of a prescribed range of electrical transformers otherwise than in accordance with certain provisions designed mainly to ensure the use of lower quality electrical sheet steel, reduce the number of sizes of transformers in the prescribed range, and eliminate certain non-essential features. This Order does not interfere with contracts made before September 30th, 1943.

Expositions in South America.—Despite war difficulties, the South American industrialists are maintaining their plans for expositions. Colombia will hold one at Bogota in December. Brazil also is arranging to hold a sizable exposition (the second in the series) at Curitiba in November. The founders of the fair, which is sponsored by the Government of the State of Para, will attempt on a small scale a fair similar to recent great international expositions, not so much in variety and volume of exhibits as in arousing interest and affording opportunity for contact between the American Republics.

Plastic Treatment for Porous Castings.—Since the appearance of our article on "The Bakelite Plastic Treatment of Porous Castings," in our issue of April 9th, Commercial Structures, Ltd., which operates the process, has, we are informed, received approximately 1000 castings for treatment at its Leyton works. A high proportion of successes has been achieved; practically the only failures are due to insufficient care being taken by the owner properly to blank off the casting, so that it is not possible to apply the requisite pressure. Owners of castings wishing to submit them for treatment should therefore bear in mind that the joints must withstand a higher pressure than the test pressure specified. In all cases it is desirable that the joints should withstand a minimum of 2000 lb. per square inch, even when the test pressure is below that figure. All apertures except the single ¼in. B.S.P. tapped hole needed for the reception of the plastic fluid should be blanked off accordingly. With proper care in this respect the proportion of castings which have been successfully treated is as high as 95 per cent.

Personal and Business

Mr. Victor Freeze has been elected a director of United States Lines.

Mr. V. F. Watkins and Mr. V. F. Terry have been elected directors of Wrights' Ropes, Ltd.

Dr. W. A. Macfarlane has been appointed Director of Fuel Efficiency in the Ministry of Fuel and Power.

The British Chemical Plant Manufacturers' Association has changed its address to 26, Portland Place, W.1. Telephone, Langham 3121.

The L.N.E. Railway announces that Mr. H. E. Stratton, Assistant to the Engineer (London) (Bridges), has been appointed Assistant to the Chief Engineer (Steelwork).

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Building Technicians

Friday, Oct. 22nd.—Westminster Hospital Medical School, Westminster, S.W.1. "County of London Plan," A. Ling. 6.30 p.m.

Bradford Engineering College

Monday, Oct. 18th.—Technical College. Film on "Fuel Economy and Boiler-House Practice." 6.45 p.m.

Institute of Fuel

Monday, Oct. 18th.—N.E. Section: Central Station Hotel, Newcastle. "The Need for Industrial and Scientific Co-operation," J. G. Bennett. 5.30 p.m.

Institution of Automobile Engineers

Sunday, Oct. 17th.—London Graduates' Section: 12, Hobart Place, S.W.1. "Automobile Industry," P. C. Kidner. 2.45 p.m.

Institution of Civil Engineers

Saturday, Oct. 23rd.—N.W. Assoc.: Engineers' Club, Albert Square, Manchester. Chairman's Address, by T. Elce.

Institution of Electrical Engineers

To-day, Oct. 15th.—S. Midlands Students: Loughborough College, Loughborough. "Turbo-Alternator Ventilation," H. R. Ogle. 6.30 p.m.

Saturday, Oct. 16th.—N. Midland Students: College of Technology, Cockridge Street, Leeds. Chairman's Address, by J. V. Werrell. 2.30 p.m.—S. Midland Centre: Grand Hotel, Birmingham. Chairman's Address, by D. Kingsbury. 12.30 for 1 p.m.

Monday, Oct. 18th.—N. Wales Centre: Liverpool Royal Institution, Colquitt Street, Liverpool, 3. Chairman's Address on "Industrial Power Supply," T. E. Houghton. 5.30 p.m.

Wednesday, Oct. 20th.—Transmission Section: Savoy Place, Victoria Embankment, W.C.2. Chairman's Address, by T. R. Scott. 5.30 p.m.

Institution of Mechanical Engineers

Thursday, Oct. 21st.—N.W. Branch: Engineers' Club, Albert Square, Manchester. "Surface Finish and the Function of Parts," G. Schlesinger. 6.45 p.m.—Midland Branch: Birmingham Technical College, Suffolk Street, Birmingham. "Combustion," Professor G. Scholes. 5.30 p.m.—S. Wales Branch: Mackworth Hotel, Swansea. Chairman's Address, by J. Selwyn Caswell. 3 p.m.

Friday, Oct. 22nd.—Storey's Gate, Westminster, S.W.1. Presidential Address, "Remember the Past and Look to the Future," Professor F. C. Lea. 5.30 p.m.

Saturday, Oct. 23rd.—Southern Branch: Kimbell's Restaurant, Osborne Road, Southsea. "Naval Machinery: Some Factors Influencing its Design," Eng. Vice-Admiral Sir George Preece. 2 p.m.

Institution of Production Engineers

To-day, Oct. 15th.—Leicester Section: College of Technology, Leicester. "Engineering Properties of Rubber and Application of Rubber to Metal Weld Devices," J. E. Moyal. 7 p.m.

Wednesday, Oct. 20th.—Birmingham Section: James Watt Memorial Institute, Birmingham. "Furnace Copper Brazing as an Aid to Production," N. G. Gillard. 7 p.m.—Manchester Section: College of Technology, Manchester. "High Speed in the War-time Production Shop," G. Schlesinger. 6.45 p.m.

Institution of Professional Civil Servants

Tuesday, Oct. 19th.—Inst. of Mechanical Engineers, Storey's Gate, Westminster, S.W.1. "Radio and International Relations," Sir Stafford Cripps. 5 p.m.

Institution of Sanitary Engineers

Friday, Oct. 22nd.—Caxton Hall, Westminster, S.W.1. "The Corrosion of Mains in Clay Soils," H. J. Bunker. 5.30 p.m.

Institution of Water Engineers

Saturday, Oct. 16th.—Midland Section: South Staffordshire Waterworks Company, Birmingham. General meeting. 2 p.m.

Junior Institution of Engineers

To-day, Oct. 15th.—39, Victoria Street, Westminster, S.W.1. "Research for Junior Engineers," R. A. Collacott. 6.30 p.m.

Friday, Oct. 22nd.—39, Victoria Street, Westminster, S.W.1. "Mechanisation of Mines," J. K. Davies. 6.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, Oct. 15th.—Literary and Philosophical Society, Newcastle-upon-Tyne. Presidential Address, by J. Ramsay Geddie. 6 p.m.

Physical Society

To-day, Oct. 15th.—Royal Institution, Albemarle Street, W.1. Parsons Memorial Lecture, "Optical Topics, in Part Connected with Charles Parsons," Lord Rayleigh. 4.30 p.m.

"Practical Planning" Exhibition

To-day to Saturday, Oct. 15th to 30th.—Institution of Civil Engineers, Great George Street, S.W.1. 10 a.m. to 6 p.m. (except Sundays). Conferences: Wednesday, October 20th., "Improved Methods of Lay-out and Construction of Roads, and the Use of Motorways, with Special Reference to Safety on Roads," and Wednesday, October 27th, "Alternative Materials and Methods of Construction in Buildings." 2.30 p.m.

Women's Engineering Society

Friday, Oct. 22nd, to Monday, Oct. 25th.—Annual conference at Manchester.